In This Issue **EUROPE'S AIR STRENGTH TODAY** *by T. P. Wright*

McGraw-Hill Publishing Company, Inc. APRIL, 1940 Price 35c. per copy

AVIATION

The Oldest American Aeronautical Magazine

B-24

...owered by Four Twin Wasps

Into Army service goes another four-engined bombardment type, the Consolidated B-24. Weight: 20 tons. Range: 3000 miles. Speed: more than 300 M. P. H. Power: dependable Pratt & Whitney engines.

PRATT & WHITNEY AIRCRAFT

One of the three divisions of

UNITED AIRCRAFT CORPORATION

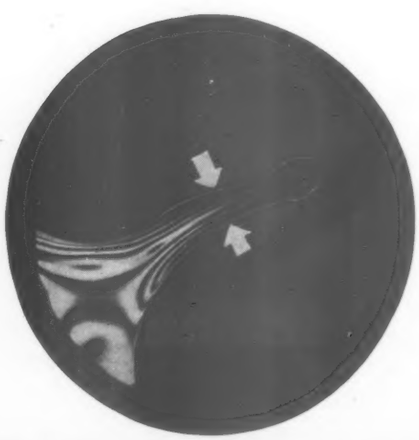
EAST HARTFORD, CONNECTICUT

Fingerprinting VALVE STRESSES *with* POLARIZED LIGHT

• The new science of photoelasticity which clearly reveals the location and degree of stresses in working metal, is employed by Thompson Products engineers to improve various aircraft engine parts. The photoelastic illustrations on this page are from a study of aircraft valve design made by the company's research department.

Above are two cross-sections, made of a plastic material, ¼-inch thick, of slightly different designs for an aircraft engine intake valve. The design at the right specified a greater thickness at the point shown by the arrows.

Under a polariscope, while subjected to identical loads (12.55 pounds, pulling downward on the stem ends) the plastic cross-section on the left reveals *five* stress patterns at the points of maximum strain, while the one at the right shows but *four*. The photoelastic comparison demonstrated with certainty that the slightly different design at the right will result in a valve materially stronger at the point of greatest stress under actual conditions of operation.



THOMPSON PRODUCTS, INC., MANUFACTURES OVER 1,000 AIRCRAFT ENGINE AND AIRPLANE PARTS, IN APPROXIMATELY 70 DIFFERENT CLASSIFICATIONS, INCLUDING VALVES, VALVE SEAT INSERTS, VALVE KEYS, VALVE SEATS, VALVE TAPPETS, FUEL PUMPS, PROPELLER PARTS, SHOCK ABSORBER PARTS, RETRACTABLE STRUT ASSEMBLIES AND LANDING GEAR ASSEMBLIES.

THOMPSON PRODUCTS, INC.
CLEVELAND • DETROIT

Thompson Products

AVIATION

Established 1916

THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

APRIL 1940

Vol. 39, No. 4

CONTENTS

REGULAR EDITION

Flashes 27
Picked Up Along Editorial Airways

Side Slips 31

Winged Victory *By T. P. Wright* 32
Allies Overtake Germany in Airplane Production

Wright Field 34
Heart of the Army Air Corps

Air Corps Proving Ground 36
Wright Field Tests Air Corps Equipment

Pilots Are Human Too 38
Research Helps Them to Do a Better Job

Airline Safety Through Teamwork *By Carl Norcross* . 40
Celebrating a Year of Airline Safety

Keeping Them Aloft *By Leslie E. Neville* 42
Light Plane Maintenance Under the CAA Flight Program

U H F *By W. E. Jackson* 44
Part II of an Article on Short Wave Radio Development

Cabin Superchargers . *By David Gregg* 46
Getting Cabins Ready for the Stratosphere Ships

Quantity Production of Small Radial Engines 48
Turning Out 150 Engines a Month *By Gunnar Edenquist*

AVIATION'S Sketchbook of Design Detail 52
Cutaway Drawings and Detailed Sketches

Amber Lights for Runways *By W. C. Norvell* 54
How Sodium-Vapor Lights Can Help Pilots

High Octane Gasoline or Safety Fuel? 57
Which Will it be in the Future? *By J. R. MacGregor*

Let's Use Decimals! *By Curtis L. Bates* 58
Why the Decimal System is Better

Synthetic Rubber Takes to the Air *By H. M. Koelliker* 62
Its Many Uses in Aircraft

Flying Equipment 64

New Ryan Dragonfly .... 64 — Johansen JA-2 69
Porterfield Trainer ..... 66 — Briegleb Glider 69

Buyers Log Book 74
A Review of New Equipment for the Industry

The Aviation News 77

National Aviation ..... 78 — Aviation Manufacturing .. 86
Washington Windsock .... 79 — Aviation Engineering 89
National Defense ..... 80 — Transport Aviation 90
Aviation People ..... 82 — Finance 92
Aviation Abroad ..... 84 — *By Raymond Hoadley*

Operators Corner 95
Tagging the Bases with Les Neville

Leslie E. Neville, *Managing Editor* — **George W. Pfeil**, *Manager*

Carl Norcross, *Assistant Editor* — **J. Pearce AuWerter**, *Assistant Editor*

Donald G. Fink, *Radio Editor* — **Blaine Stubblefield**, *News Editor*

Charles F. McReynolds, *Pacific Coast Editor*

Paul Wooton, *Chief of Washington Bureau*

McGRAW-HILL PUBLISHING COMPANY, INC.
James H. McGraw, Founder and Honorary Chairman

Editorial and Executive Offices:
330 West 42nd Street, New York, N. Y.

Publication Offices:
99-129 North Broadway, Albany, N. Y.

Chicago, 520 North Michigan Ave. — San Francisco, 68 Post Street
Los Angeles, 9121 Dalton Ave. — Aldwych, London, W. C. 2

Washington: Philadelphia: St. Louis: Boston: — Cleveland: Detroit: Atlanta, Ga.

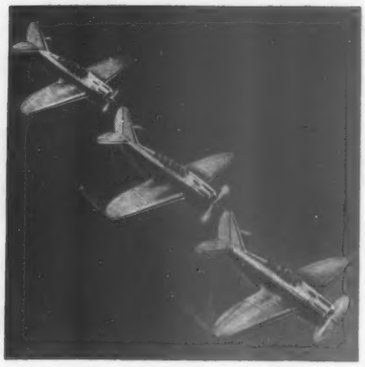
JAMES H. McGRAW, JR., President — HOWARD EHRLICH, Executive Vice-President

MASON BRITTON, Vice-Chairman — B. R. PUTNAM, Treasurer

D. C. McGRAW, Secretary — J. E. BLACKBURN, JR., Director of Circulation

Published monthly, price 35c a copy. Subscription rates—United States, Canada and Latin America republics, $3.00 a year. All other countries $5.00 a year or 30 shillings. Entered as second-class matter September 3, 1936, at the Post Office, Albany, N. Y., U. S. A., under the act of March 3, 1879. Printed in U. S. A. Cable address: "McGrawhill New York." Member of A. B. C.

Copyright 1940 by McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York, N. Y. The following publications are combined with AVIATION: AERONAUTICAL ENGINEERING, AIRCRAFT JOURNAL and THE AVIATION NEWS. All rights to above names are reserved by the McGraw-Hill Publishing Co.

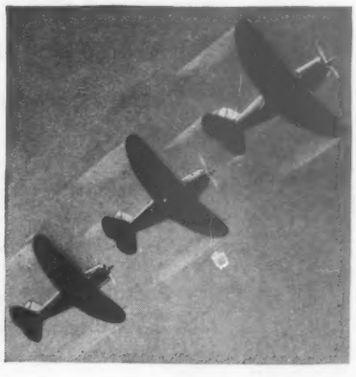


REPUBLIC IS READY

When the name Seversky was succeeded by the name REPUBLIC, a new emphasis was applied within the organization—emphasis which the present management places on superlative Man Power, *the greatest single force in aviation.*

The management of this corporation, adhering to a tradition for brilliant engineering and fine craftsmanship, has demonstrated that emphasis on Man Power not only produces better planes but expedites production under the most exacting standards of inspection.

Every division of the REPUBLIC organization —Engineering, Purchasing, Production, Administration—benefits by this policy which places upon management three primary responsibilities: Selection of men who possess the right natural ability, both technical and personal. Utilization of each man's proved ability. Recognition and reward for superlative performance.



It follows that REPUBLIC produces some of the finest military airplanes in the world. REPUBLIC planes are now in the service of five nations on four continents. Recent, current and forthcoming designs include the U.S. Army Air Corps' P-35, XP-41, YP-43 and P-44 airplanes; the EP-1 and 2-PA export designs; the Warrior and Guardsman types. Four new airplanes are now moving from the drawing boards to the production lines.

As manufacturers exclusively of Pursuit and Fighter Aircraft, REPUBLIC is proudest of its continuing relationship with the Army Air Corps, to which it is indebted for support and guidance in every major advance in design, and of its cordial association with the Bureau of Aeronautics of the Navy Department.

REPUBLIC is ready — for today's job and tomorrow's!

REPUBLIC AVIATION CORP.

FARMINGDALE, LONG ISLAND • NEW YORK

Flashes

Picked Up Along Editorial Airways

IN THIS ISSUE

Leading article this month is by our friend T. P. Wright, who presents the most recent facts on the much discussed question of German vs. Allied airplane production strength. At the time of Munich, Germany had two and one-half times as many planes as the Allies, but British and French factories, including planes from U.S., are already turning out more ships than is Germany, and in total airplanes, Allies will overtake Germany early in 1941. . . . We pay our respects to the fine work being done at Wright Field by offering six pages of splendid photographs taken recently at Dayton, showing views of experimental work that keeps our ships first in the air. . . . Domestic airlines in March established a new world's record for safety. In commemoration of this achievement we present a few orchids to the teamwork that made it possible. . . . More than 1,000 light airplanes are being maintained under an identical system in the CAA Pilot Training Program. In *Keeping Them Aloft* this maintenance story is told. . . . Short wave radio will play an important role in aviation. W. E. Jackson continues his basic discussion. . . . Cabin supercharging is already here, with the first of the four-engined ships now being delivered. David Gregg tells the story. . . . The Kinner engine plant is under new management and is turning out 150 radial engines a month. How they are being produced is told by Chief Engineer Gunnar Edenquist. . . . AVIATION'S Sketchbook brought cheers from a delighted audience when it began in the February issue. It was continued in the last issue and will be continued this month. . . . Sodium-Vapor lighting is handled by W. C. Norvell. . . . The timely question of high octane gasoline vs. safety fuels is skillfully presented by a well-known fuel engineer, J. R. MacGregor. . . . Curtiss Bates does some rooting for the decimal system, and H. M. Koelliker tells how synthetic rubber is being used in aircraft. In our flying equipment section we tell you about the new Ryan Dragonfly, the Porterfield Trainer, the Johansen JA-2 and the Brieg-leb glider, . . . and the latest news from the aviation world.

» MILITARY SECRETS are sacred and should be guarded closely but, in an industry moving as rapidly as aviation, today's most brilliant accomplishments may be obsolete tomorrow. We could cite several recent examples of publication of the details of some of our secret design projects in the foreign press months before the

MODERN PIONEERS: Frank W. Caldwell (left) and Erle Martin received awards recently at the Modern Pioneers Dinner in Hartford, commemorating the 150th anniversary of the founding of the U. S. Patent System. The awards were made in recognition of their achievements in the design of aircraft propellers. Caldwell is Engineering Manager of the Hamilton Standard Propeller Division of United Aircraft Corporation. He has had a long and distinguished career in propeller design work. He has received many honors, including citation in the 1933 Collier Trophy Award to the controllable pitch propeller, and the Sylvanus Albert Reed Award in 1936. Martin, who is chief engineer of Hamilton Standard, has collaborated closely with Caldwell. He helped develop the hydraulically-operated quick-feathering propeller.

Four fly in comfort at two cents a mile in a FAIRCHILD

ONE naturally expects luxury of detail and design from Fairchild. But Fairchild owners enjoy these qualities at an operating cost whose spectacular economy often comes as astonishing news to the owners of other ships with comparable payloads.

In a Fairchild you get pampering comfort for four persons—with ample head-room, leg-room, and arm-room—easy access through two wide doors—gas capacity for six hours' cruising—*at a fuel cost of two cents a mile!*

You get dependability and ruggedness of structure as evidenced by recent CAA purchases of 33 Fairchilds for government use—uncompromising standards of engineering to assure long life, low maintenance, and minimum depreciation—*and the fuel cost is only two cents a mile!*

You get easy landings, quick take-offs, effortless flying, hydraulic brakes, steerable tail-wheel—*and yet the fuel cost is only two cents a mile!*

It takes less than a minute with a pencil—and less than an hour with the stick—to convince yourself that Fairchild is aviation's best bargain in luxury and quality—by the cost per mile—or the cost per year!

FAIRCHILD AIRCRAFT

Division of Fairchild Engine & Airplane Corporation
Hagerstown, Maryland . . . Cable Address "Faircraft"

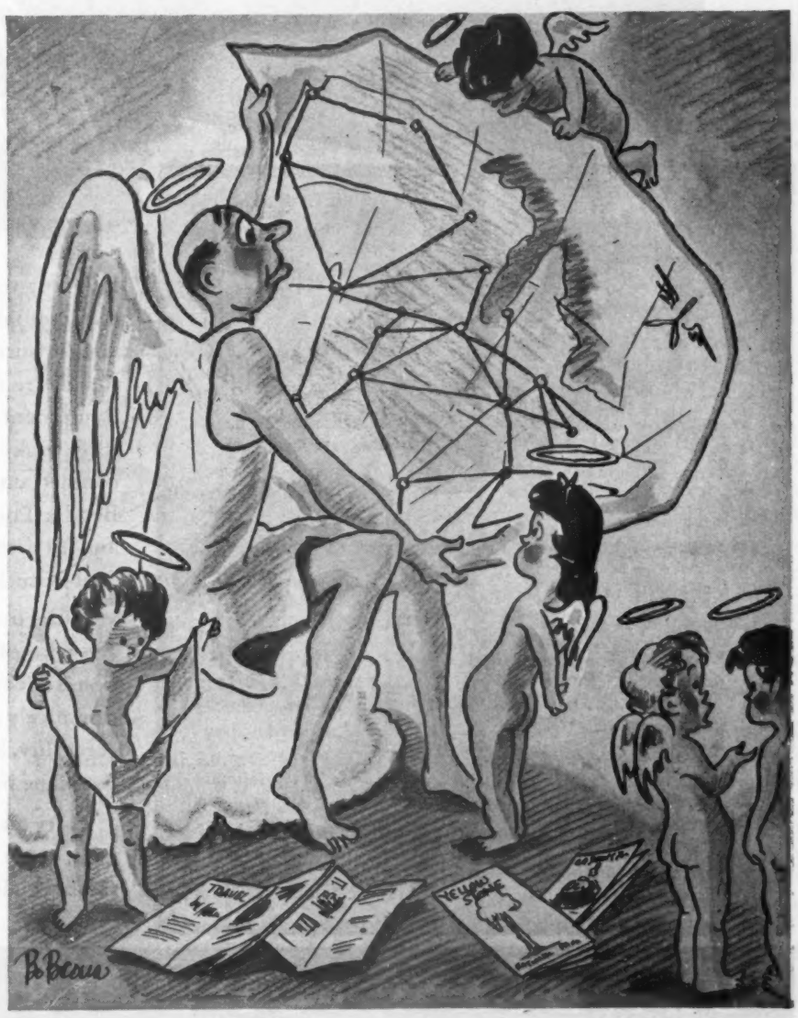
material was released here. But this is not primarily important because the finished products will be so different from the published material that they will be scarcely recognizable. Recently the Joint Board of the Army and Navy wisely decreed that all military aircraft in production were exportable after our domestic needs were satisfied. It would be difficult to devise a more reasonable arrangement. But now there is talk of Congressional investigation of release of military equipment for export. Such an investigation can accomplish no useful purpose. It is our hope that, if it is conducted, it will not interfere with the recent efforts of the Administration to cooperate in enlarging the productive capacity of the aircraft manufacturing industry for our own defense.

» SABOTAGE is a word that covers a multitude of sins. It furnishes an easy out for negligence of all sorts. Now the railroads are using it in a move to cash in on the prosperity of the aviation manufacturing business by raising freight rates. Engine manufacturers are the chief sufferers. Although fear of sabotage is given as the cause, experience shows that only one engine has been damaged in transit in the past fourteen years. The increased cost of this move is estimated at $4,000,000 annually, which would naturally be passed along to the consumer. This means that a good part of the check would be signed by Uncle Sam. It is hoped that the I.C.C. will recognize its patriotic duty if the new tariffs are filed and will hear the shipper's side of the story.

» MORE AIRPORTS for New York is the theme of a recent report of the Regional Plan Association, which surveys existing facilities and recommends several new landing areas. Perhaps this is a bad time to talk about increased facilities for this part of the country because of the widespread discussion of the high cost of LaGuardia Field. But we must remember that all airports need not be air terminals for a great city. There is an acute need for smaller fields more suited to the requirements of private flying, instruction, and miscellaneous operations. Many of these could be built for the cost of a single terminal airport. Let's get out of the million dollar class and revise our thinking toward what we could do with a couple of hundred thousands.

» AN EMPTY FIRE EXTINGUISHER is an unpardonable sin in any business. It is many times more serious in the air transport industry. Yet one of our traveling editors found a flock of them while flying as a passenger on one of the major air lines. The A.T.A., C.A.A., the air lines themselves, and other affiliated agencies, have done a remarkable job of making air travel safe. (See page 40). There is no basic reason why it should not continue to be so. But the responsibility reaches down to the fellow who fills the extinguishers on airplanes and at airports. His contribution is at least equal in importance to that of the government official or air line president. It is up to the upper personnel to impress upon him the importance of this grave responsibility.

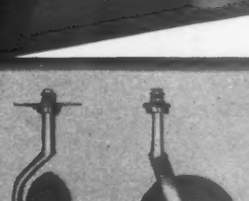
IT PAYS TO FLY



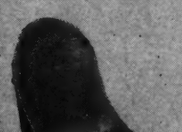
Maguire's planning his vacation and is trying to dope out the color of the airways on the new C.A.A. map.

Bendix builds the essentials of first class *Ground Performance!*

Bendix Wheel and Brake—Low air resistance, due to smooth contour; a type in general military service.



Bendix Tail Wheel Knuckles—Steerable and swivelable, thus increasing ground maneuverability appreciably.



Bendix Pilot Seat—Developed for military aircraft. Weighs 7¼ pounds. Subjected to 3800 pounds deadweight loading test.

Bendix Pneudraulic Shock Struts—The impact shocks dissipated hydraulically, taxi-ing shocks pneumatically. Designed individually for particular load requirements.

In order to have "what it takes" for landing with minimum shock, for a well-controlled taxi-ing run and for sure and smooth take-off, most modern airplanes are safeguarded with Bendix Landing-Gear Equipment. Years of painstaking analysis of every force set up during the critical moments of ground-contact, underlie the design and dimensioning of Bendix Pneudraulic Shock Struts, Bendix Wheels and Brakes and Bendix steerable and swivelable Tail-Knuckle Assemblies.

Initial impact shocks and the lesser bumps of taxi and take-off runs are efficiently absorbed; deceleration is effected in minimum distance and with direction nicely controlled; easy rolling and tail maneuverability, by hand or by tractor, facilitates moving the plane inside the hangar or on the warm-up line.

Every facility, every compilation of landing-gear data, every benefit of Bendix' years of experience in this specialized work, is at the industry's command.

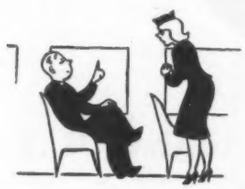
BENDIX PRODUCTS DIVISION

OF BENDIX AVIATION CORPORATION · SOUTH BEND, INDIANA

AIRPLANE WHEELS · BRAKES · PILOT SEATS · PNEUDRAULIC SHOCK STRUTS

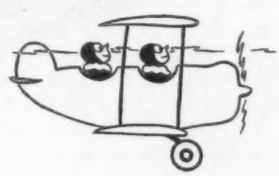
Side Slips

» SOMEHOW our male nature has always been a bit subdued in the presence of those self-sufficient stewardesses aboard the transports. We feel unchivalrous, watching one tug at a berth that won't come down, but don't dare offer to help. Maybe she wouldn't let us, or maybe *we* couldn't yank it loose *either*. If we had a date with a stewardess (a secret hope), we'd be thinking that if her plane landed in a desert with us aboard, she'd sure be first to find a water-hole, and lead us to it. Feeling that way we just never could turn our magnetism on a stewardess. But now that's all changed. The other



day Chief Pilot Freng of United Air Lines was telling about a stewardess who quit, right in the middle of a trip. Weather churned the flight pretty bad, scared this gal so she took her little bag and got out at some way station, and they never saw her again. From now on we're going to be masterful with stewardesses; if necessary we'll tell them that story.

» THE LAST TIME we saw Mr. Freng, until the other day, was about ten years ago, at Reno. Four of us *had* to get to San Francisco; five, with the pilot, in a Boeing 40-B, which carried two in the cabin. All of our grandmothers were dying. So the tender-hearted Mr. Freng took half the lid off his mail pit, and put two of us in with the sacks. Maybe that was the only time five people ever rode in a Boeing 40-B, for all we know. There were no rules in those days. The moon was shining on the late Sierra snow drifts. It was swell; one of those few times in a lifetime. But even on such a spring night, one doesn't expect to smell perfume 10,000 ft. over the Sacramento valley. But we did. After we landed Mr. Freng said he smelled it too. We agreed it was orange blossoms, for it was blossom time in the valley. But when we reminded him of this the other day, he pretended not to remember. "What a tall story *that* is," he said. We know what's the matter with Mr. Freng. He doesn't *want* to remember. He and the other



boys are getting pale faces from flying in air-tight cabins. It makes his heart ache to think of the days when airmen rode in the open air, and could smell orange blossoms.

» THE JUSTICE DEPARTMENT assigned several G-men to study the incident of two Canadian military fliers forced down in New York State. It's nice to think that our great Government can hold a steady hand on the wheel as tempests shake the earth, and at the same time, mark the sparrow's fall. Mr. Hoover already knows that the Canadian pilots came down because they ran out of gasoline. They said so. But the Government wants a file of letters and reports to prove it. We can see this bundle of papers now, tied with pink tape, resting in a vault in the Archives Building 800 years hence. The researchers of that far-off day, writing essays on the era when aircraft had wings, will find it, and marvel at our efficiency

They might even estimate the cost of the investigation and find that it was, for example, $602.35.

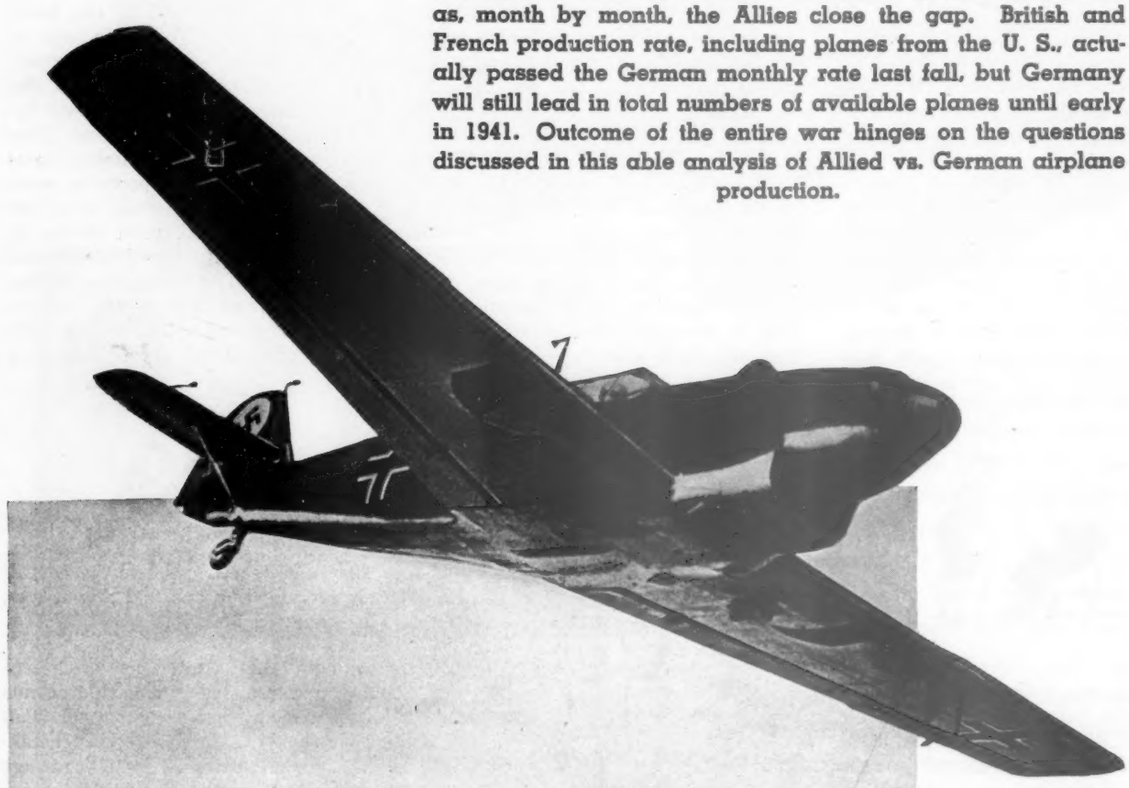
» YOU ALL KNOW how some of the greatest scientific achievements were made by precocious boys or adult tinker-boxes. Here's one, just breaking into circulation. Some years ago the experts in an engine laboratory were testing a 750 horsepower job. One day they started it up and it turned out 1000 horsepower. A miracle! You can't have that sort of thing among engineers, so they took the engine apart. Everything was normal—except they had forgotten to put oil in it. So they rigged up a new sump pump that would cut down the oil splash. That's the way it was told to us.

WINGED VICTORY

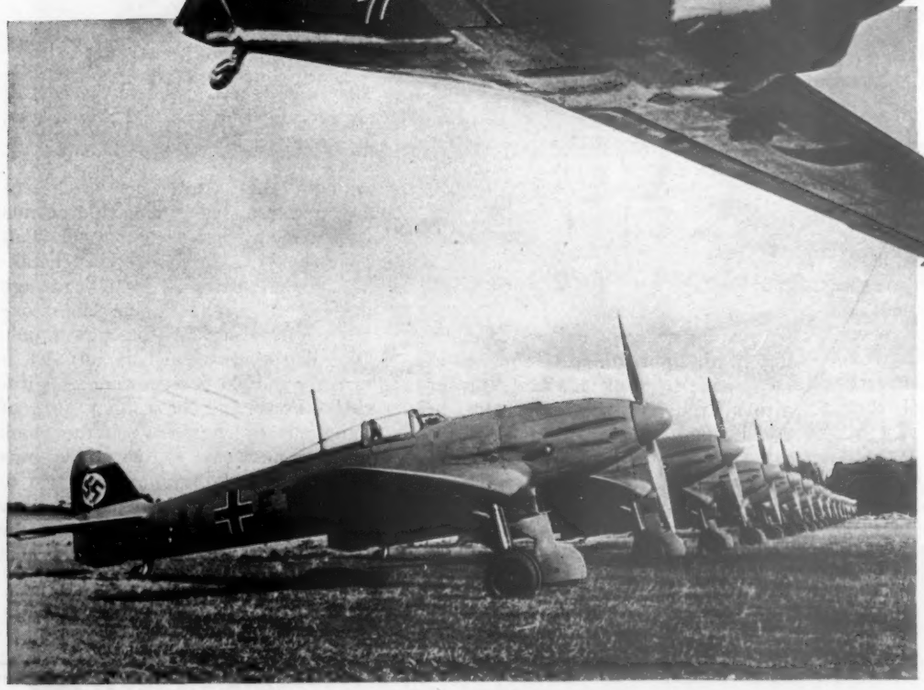
for the Allies becomes more likely

WHILE GERMANY WAITS

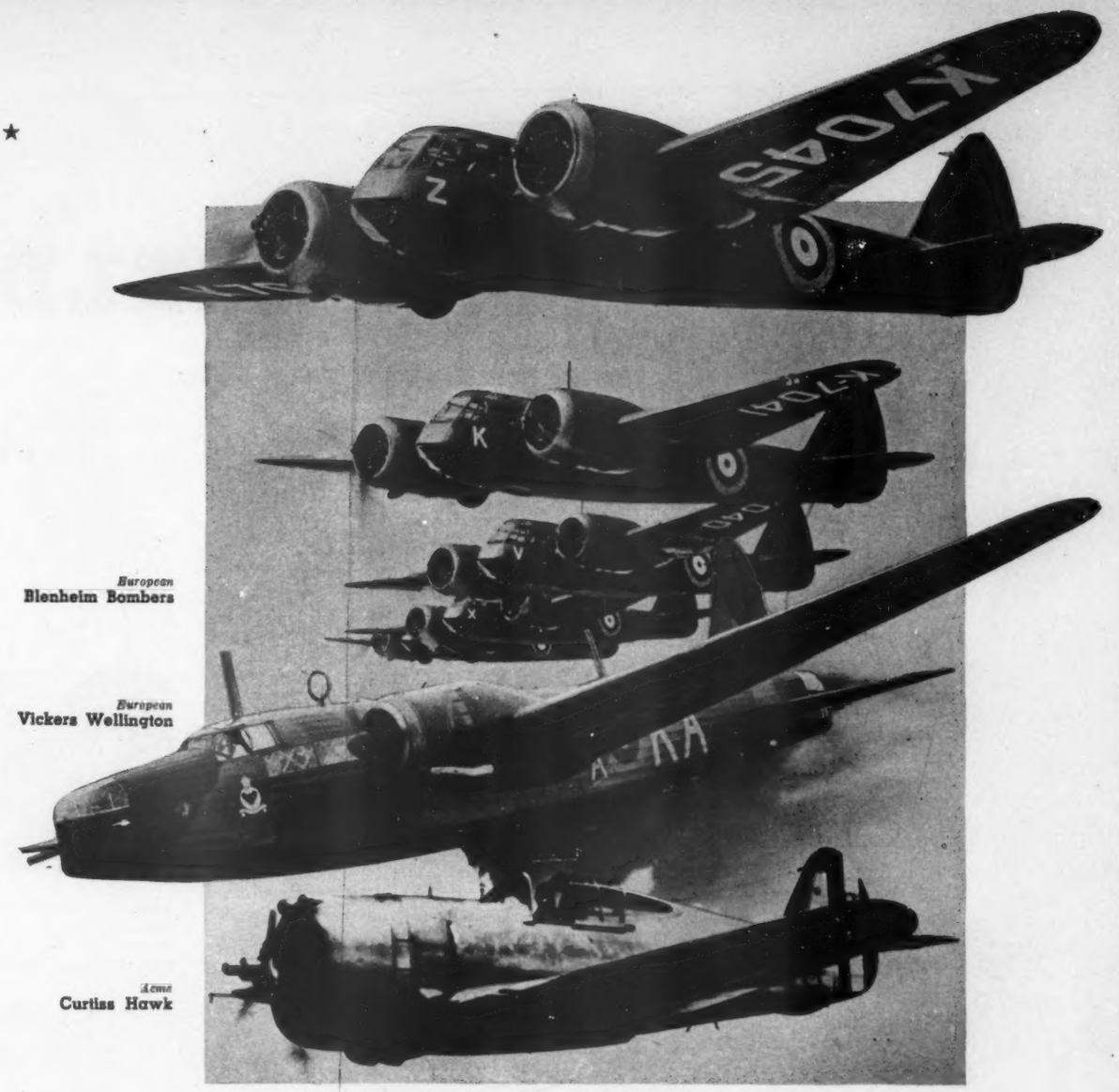
Hitler missed his chance at Munich. Then he had two and one-half times as many airplanes as the Allies. The tide is now turning and Germany's chance for success grows steadily less as, month by month, the Allies close the gap. British and French production rate, including planes from the U. S., actually passed the German monthly rate last fall, but Germany will still lead in total numbers of available planes until early in 1941. Outcome of the entire war hinges on the questions discussed in this able analysis of Allied vs. German airplane production.



Acme
Messerschmitt Me 109



European
Heinkel He 112



European
Blenheim Bombers

European
Vickers Wellington

Acme
Curtiss Hawk

By T. P. Wright
Vice-President of Engineering
The Curtiss-Wright Corporation

IN June 1939 AVIATION magazine published an article of mine entitled "America's Answer," in which was discussed the capacity of our aircraft industry to meet the needs of national defense as advocated by the President and authorized by the Congress. The conclusion was reached that the industry would be capable of meeting the delivery schedules required with but a ten per cent expansion in floor space. It was assumed that export orders would continue in quantities that approximated those then current and I hedged only to the extent of stating that "in case a war should start, all bets are off."

Then in September, the war in Europe broke out. Orders poured in from abroad, and as a consequence, there has been an expansion in the industry of approximately 40 per cent in floor space as against the ten per cent previously assumed. As the capacity and output of our expanding airplane industry may have an important bearing on the outcome of the war, it appears desirable again to survey the production situation at home with particular reference to shipments which will be made abroad and, as well, the resulting air strength of the belligerent countries.

So much of a conflicting nature has been written of late concerning the air power of the nations at war and our capacity to deliver planes to the Allies while we at the same time build up our own air forces, that considerable confusion exists. Practically every new issue of current magazines and periodicals, both in trade journals and in the popular magazines outside the industry, contain estimates of monthly production rates and total air strength of the countries at war. There are frequent discrepancies between these

(Turn to page 102)

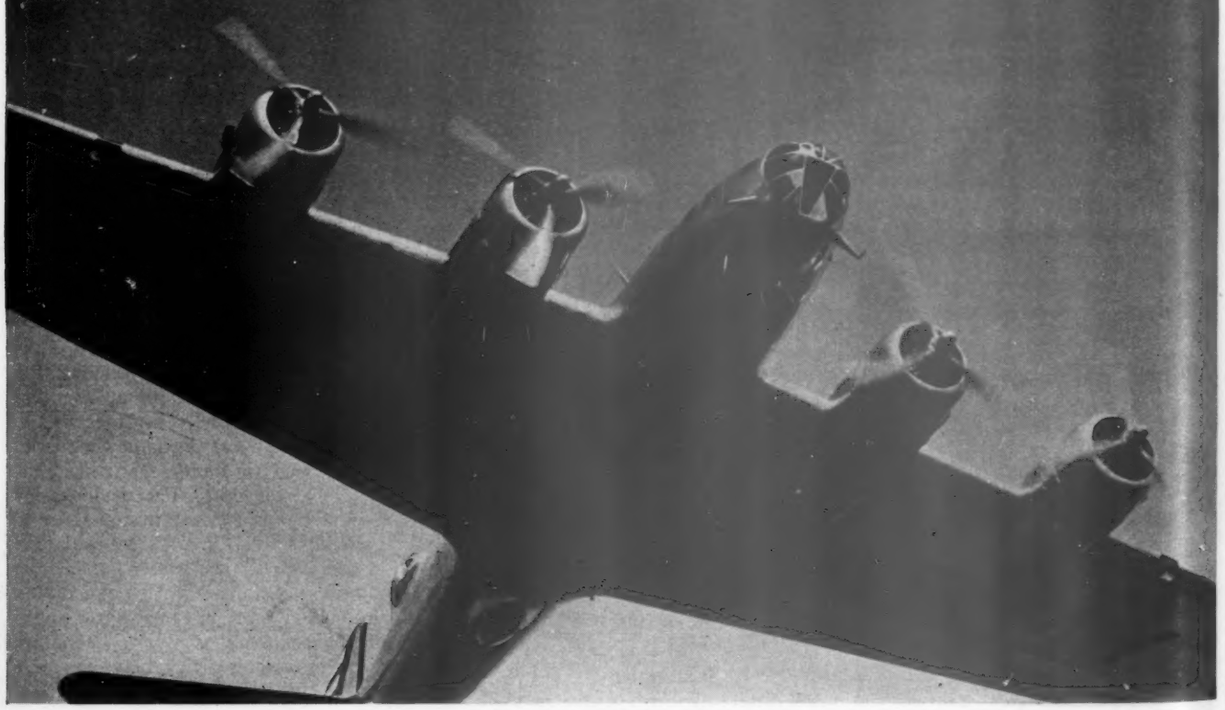
WRIGHT FIELD

Heart of the Army Air Corps

ONE of the greatest single factors that keeps U. S. military planes leading the world parade is Wright Field at Dayton, Ohio. Here new designs are conceived, specifications drawn, orders issued and finally, finished airplanes and parts are tested. The Field is part of the Air Corps' Materiel Division — and materiel means every ounce of equipment from a rivet to a complete flying field. In the 750 acres are 50 hangars, shops, laboratories, and a 500-acre flying field. Some 200 Air Corps officers supervise about 2,500 civilians. In the twelve months preceeding last October, Air Corps contracts of approximately $200,000,000 were passed on at the Field, indicating a vast business enterprise as well as a scientific laboratory.

Every American plane, commercial and military, is more efficient due to research done at Wright Field. Improved types of engines, superchargers, high octane gasoline, night airways, airport lighting and many other now-common devices originated at Dayton, as well as propellers having less vibration, improved instruments, de-icers, radios, and much other equipment. Photographs on these six pages represent many activities that make Wright Field famous.

Armament installations must be efficient both aerodynamically and in fire power. Below: U. S. Air Corps' mighty weapon, a Boeing Flying Fortress.



History is made around this table, where the Pursuit Board weighs the evidence that keeps our "P" ships the best in the world. At this conference are, l. to r., Major W. A. Wood, Gen'l Staff Corps; Major A. J. Lyon, Executive, Materiel Div., Washington; Major George C. Kenney, now in Paris; Brig. Gen. Jacob E. Fickel, Ass't Chief, Materiel Div., Washington; Lt. Col. Carl Statz, office, Chief of Air Corps, Washington; Lt. Col. E. L. Maiden, Gen'l Staff Corps, Langley Field; and Lieut. Col. L. M. McClelland, Gen'l Staff Corps.

Right, Brig. Gen. George Brett, Ass't Chief of Air Corps, is Chief of Materiel Division and boss of Wright Field. He flies his own ship, a Douglas bomber.

During flight tests at Wright Field a ship is given "the works" by Major Stanley Umstead or one of his expert test pilots. Every Army type has been tested, from light trainers to Flying Fortress. The Major flies the big jobs himself.

An important conference. In center is Lt. Col. Oliver P. Echols, Ass't Chief of Materiel Div. and in charge of Wright Field since General Brett moved to Washington. Left is Major F. O. Carroll, Chief of Experimental Engineering at the Field. Right, Major A. J. Lyon, Materiel Div. Executive, located in Washington. Under Major Carroll are such laboratories as experimental aircraft, engines, materials, armament and equipment. These men typify engineer-scientists who lead our Air corps.

Anti-knock qualities of various gasolines are tested in this one-cylinder engine. Compression ratio, spark, fuel-air ratio and other characteristics can be varied in the engine, producing different conditions. High octane gasoline was first developed here.

Homer Jacobs and the wind tunnel model of the P-37. For testing propeller and slipstream reactions a controllable pitch rotating propeller is used on the stub-winged model (so that maximum sized fuselages can be tested.) A full-scale tunnel is now being built.

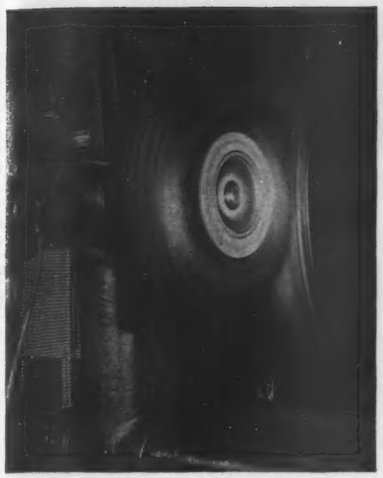
AIR CORPS PROVING GROUND

AN AIRPLANE must take a grueling punishment which no other type of equipment has to withstand. Wright Field engineers subject every part of a ship to brutal tests that ferret out any weakness. Gasoline, engines and parts, propellers, instruments, brakes, landing gear, metals, instruments, de-icer equipment and so on down the line—all must get Wright Field OK before being used for Air Corps ships. These photographs show some of the tests that make our military airplanes the envy of the world.

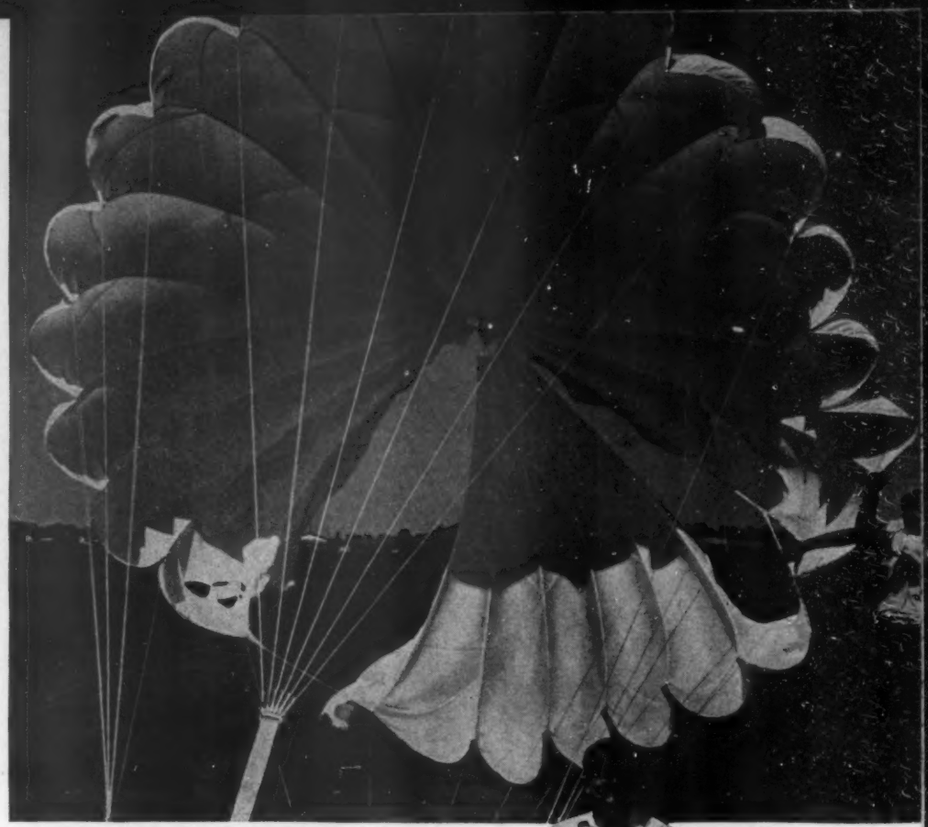
New design propellers and engines are tested when mounted in a torque stand. Circular scoop is for engine cooling. This propeller is one of a new type which has molded blades.

Rear of engine torque stand showing sturdy engine mount. Exhaust ports are connected to large tubular ring. Fuel pipe at right.

Forces developed in aircraft engines are computed and measured in the Dynamometer Laboratory. Engines are run at varying speeds as engineers take readings in adjoining room on standard data forms.



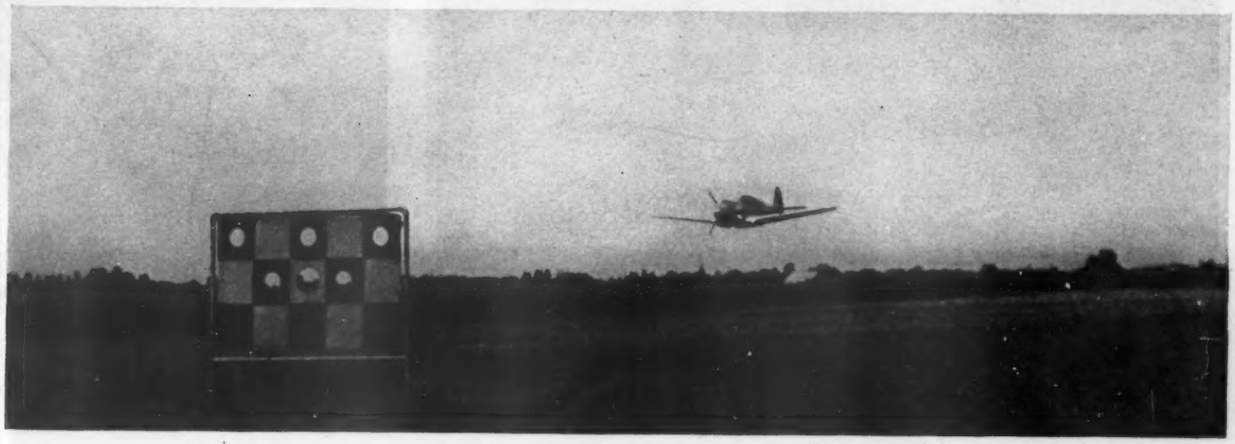
Wheel brakes for Army ships must be dependable. Brake power can be computed on this machine. As wheel is turned by master drum the brake is applied and the braking force measured.



While Capt. George E. Price was testing a new trainer last year he had to jump when it spun in. His 'chute was torn by ship but brought him down safely. Later 'chute, shown here, was dummy tested, was still ok. Wright Field did much to develop the modern parachute. Hundreds of tests yearly are made with dummies.

One of Wright Field's propeller test rigs, largest in the world. Props up to 45 ft. diameter can be whirl tested up to speeds of 4,300 r.p.m. Right: attendant carrying 'chute dummy.

No one guesses as to airplane speed at Dayton. Ships fly two ways over a measured mile, while timers accurately check their speed. Here a pursuit, P-40, approaches a marker. Speed is but one of many characteristics tested in flights.

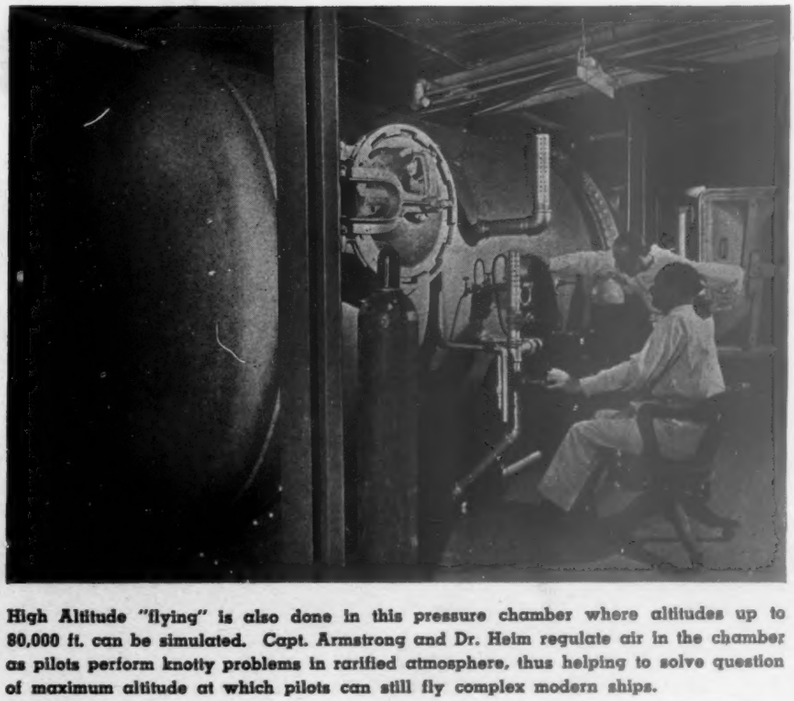


Medical research in the air. Under Capt. Harry Armstrong, M. D., Wright Field has made important contributions to problems of pilot health. Before high-flying ships are built, Army must have basic facts about altitude effects on men. This shows interior of pressurized Lockheed. Left, Dr. J. W. Heim, center, Capt. Armstrong, making a blood test.

Capt. Thomas Thurlow, navigation specialist, who was loaned to Hughes' world flight, works new navigation methods in a specially equipped airplane at Wright Field.

PILOTS ARE HUMAN TOO

and research helps them do a better job



High Altitude "flying" is also done in this pressure chamber where altitudes up to 80,000 ft. can be simulated. Capt. Armstrong and Dr. Heim regulate air in the chamber as pilots perform knotty problems in rarified atmosphere, thus helping to solve question of maximum altitude at which pilots can still fly complex modern ships.

Stratosphere flying brings extremely cold air. This picture was taken at 35 below zero in a refrigerated chamber. Capt. Armstrong and Dr. Heim check blood condition.

Radio test Douglas with, l. to r., Capt. H. F. Gregory, Paul Kreager, Capt. D. Doubleday.

Following ground tests, engines are installed on ships with much special equipment and run many hours in the air.

Ships may be kept at Wright Field for months while exhaustive tests are made. Here is a Flying Fortress having its engines gone over. Long tail projects outside hangar.

Radio Engineer W. C. Eaton, testing equipment in Radio Flying Laboratory. This ship has many experimental devices such as roof antenna in photo at left. Signal Corps officers cooperate in radio work.

AT Wright Field a great deal of far-sighted work is done to make the pilot more efficient as well as more comfortable. Capt. Harry Armstrong has performed a monumental task in improving the physiological side of flying and in lessening strain and fatigue. The Equipment Section under Major Cummings has given Army pilots warmer flying suits, better parachutes, and improved personal equipment of many kinds, including well-designed crash kits for forced jungle landings. If weather is poor today a pilot can depend on his engines, efficient radio equipment, better navigation methods and such fine instruments that he may make zero-zero landings.

Blind landing ship, Lockheed C-40-B with specially designed nose wheel to facilitate instrument landings. Since Capt. A. F. Hegenberger made first solo blind landing in 1932, Air Corps has led world in such research. Its work is basis for all systems.

AIRLINE SAFETY THROUGH TEAMWORK

TWA meteorologist works closely with pilot and dispatcher.

U. S. airlines are celebrating one full year of safety, during which time no fatality has occurred. In the twelve months ending March 26, domestic airlines carried over two million passengers some 805,000,000 passenger-miles in complete safety; a new airline record.

EARLY on the morning of Tuesday, March 26, there were some 50 huge air transports flying through the darkness. A number were flying coast-to-coast schedules, others were winging their way from Chicago down through the Southwest, or carrying overnight passengers and mail up and down the East Coast. Out in the Northwest pilots were flying high over the Rockies. Passengers were asleep in their berths or dozing in their chairs. Few were aware that they were making air transport history.

All that night pilots and operations men had been staring at their watches and clocks as minute after minute ticked by. Midnight rolled around, then one o'clock, then two o'clock, then two-fifteen, two-thirty, two-forty-five, forty-six, forty-seven, forty-eight.

At two-forty-eight that morning a new aviation record was made that had never before been equalled anywhere in the world. Airliners within the United States had flown 805,000,000 passenger-miles and completed an entire year without a fatality to passengers or crew.

United Air Lines' flying laboratory. This large ship has been fitted with much special radio and navigation equipment to improve flight operations.

Link Trainer. All airline pilots study to improve technique.

Eastern Air Lines maintenance mechanic at work.

If one passenger had done all this traveling, he could have flown in perfect safety from Los Angeles to New York every day for 844 years, or around the World at the Equator some 32,000 times. The United States airlines had hung up a record for safe travel that was not equalled during that twelve-month period by any other form of transportation in any country.

Year by year the airlines have improved their safety records. The story of how they have accomplished this remarkable record is one of the most dramatic and heart-warming annals in American industry.

Six groups of men have worked together to achieve this airline record. They have labored unselfishly, working days and nights, week-ends and holidays. One thought has been uppermost in their minds: make airline flying safe. No single group of men should get all of the credit. It has been a cooperative effort.

Work Within the Airlines

First in our hall of fame are men within the airlines. From airline presidents down to sweepers in the shops they have done a heroic job. Officials in operations departments have kept open minds. Tradition has not tied them to obsolete methods. Any suggestion that might have led to greater safety was listened to, considered carefully, and if it had merit, tried out. The lines are being led by progressive, forward-looking men.

Airline pilots have steadily improved their flying technique. Today they are better pilots than ever before. They know more about their airplanes, their engines, instruments and radio. They know a lot more about the weather. No present-day pilot stands still from a technical viewpoint. He is constantly learning. He must keep on learning and improving or his place is taken by someone who knows more about flying than he does. Every line has a pilot school where old as well as new pilots keep in touch with new developments. Instrument flying is practiced in the Link trainer and in specially fitted instrument ships. Pilots go through instrument instruction until they are perfect in all instrument maneuvers. Their entire attitude is more professional than it used to be. They take their work with great seriousness. At all times they are getting the constant and close supervision of wise old heads at the top of the operations department.

By Carl Norcross
Assistant Editor, AVIATION

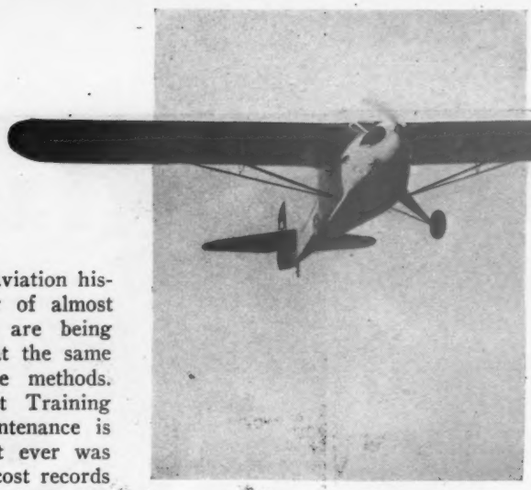
Flying is better today because of better cooperation between the men on the ground and the men in the air. Only a few years ago a dispatcher was a clerk who had been moved up to handle certain additional clerical matters. The pilots had no confidence in dispatchers' judgments. Today a dispatcher is a valuable man on the flying team. If he is not a pilot he has had years of airline experience. He is a high caliber specialist in flight operations. When he gives the pilot advice about ground conditions or advises him on an orientation problem, the pilot listens because he knows he is getting good advice.

Airline meteorologists are contributing a great deal to airline safety. Each year as they pile up more experience their predictions become more valuable. They are aided in their work by getting better and more widely distributed weather reports. Formerly upper air conditions were reported by govenment-employed pilots in fourteen locations throughout the country who went aloft with sensitive instruments. Now airplanes have been replaced by small balloons that are sent up at 2 a.m. EST., from over 35 locations throughout the country. There are also more ground reports, especially more reports from points off the airways. Hence there are fewer gaps in the weather maps.

Airlines today share their weather information, a thing that seldom used to happen. Three highly-competitive lines fly the Chicago-New York run. Yet if pilots from one line report a freak storm that may have drifted across the routes, the other lines are promptly notified. In conjunction with better information about the weather, the lines are now much more prompt to cancel trips due to poor weather than they were a few years ago.

Pilots have better radio equipment today. The airlines have had more experience with radio equipment and this has brought a preventive factor in instrument maintenance. Parts that may become defective are changed before any trouble may develop. New equipment, such as improved direction finders, are provided.

(*Turn to page 119*)



KEEPING THEM ALOFT

Under the CAA Flight Training Program operators are doing the best job of maintenance in light plane history—and learning sound operating methods at the same time. Herein a few tips to operators not taking part in the program.

By Leslie E. Neville

Managing Editor

FOR the first time in aviation history, a large number of almost identical small airplanes are being serviced and maintained at the same time and with the same methods. Under the Civilian Pilot Training Program light plane maintenance is being done better than it ever was before and such accurate cost records are being furnished C.A.A. that at the end of the school year any operator will be able to tell how his costs compare with those at other airports throughout the country.

Approximately 1,000 two-place airplanes are being used in the training program. While C.A.A. does not insist that maintenance of all ships be handled in the same way, except routine checks required for all airplanes, maintenance forms have been distributed for optional use. They are so much better than the old hit-or-miss methods used by most operators in the past that they are being adopted by the majority of operators teaching C.A.A. students.

For a number of years it has been apparent to anyone who visited a large number of fixed-base operators that among the many weaknesses, existing, two stood out predominately: a lack of efficient maintenance practices, and an almost complete lack of sound business methods. Whatever else the C.A.A. flight training program brings to American aviation, it should go a long way to cure these two evils.

First as to maintenance, C.A.A. has recognized the rugged individualism that exists among many operators, realizing that only a man with a strong and tenacious character could have survived conditions that many of these operators have gone through. A number of them have had efficient maintenance systems based on Army and Navy standards, or on systems they have worked out over a period of years. To them C.A.A. has said, in effect: "Here are some suggested forms. If you have something better, you are free to use it. But there must be no accidents caused by faulty maintenance."

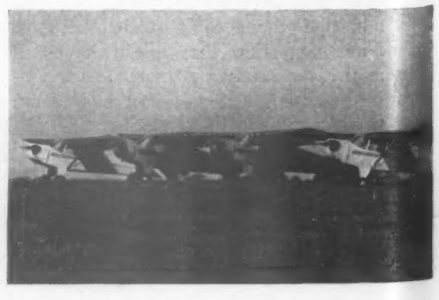
"Aircraft Maintenance Record," Form 529, is an optional record which is suggested for operators' use, one for each airplane. It is to be used only when maintenance is required. It lists 50 parts or services under six general headings: propeller, engines, landing gear, wings, tail control surfaces and fuselage. Columns are provided for time consumed in doing the servicing, number of units used in the repair, items used, unit price, and total cost. At the end of each month this one form contains a complete record of all maintenance work done on one airplane, and is signed by the mechanic who has supervised the work.

If this form is not used, the operator must keep a similar record, because at the end of each month he is required to summarize his cost of operation for each airplane being used in the program, and two items of cost for each ship are parts used for maintenance and mechanic's labor. Most operators find it is easier to use the C.A.A. form than one of their own, and many like the form so well they are using it for all their airplanes.

Criticism of the government form is primarily that it involves too much paper work. One well-established operator who for years has had his books gone over regularly by an accountant, said so much detailed information was not necessary. "I have two mechanics taking care of eight ships used in the C.A.A. program," he said. "At the end of the month I know what my labor cost is, what parts and repairs have cost and I divide the total cost by eight to get the cost per ship. It makes no difference to me that ship *A* costs me more this month, and ship *B* next month because a student may have broken a landing gear. What is important to me is the average cost over a long-time period. And I know that from my own bookkeeping." Another operator objected to keeping stop-watch time on each little repair job a mechanic did. He also preferred to average his labor costs among all ships being maintained.

Another phase of the maintenance program is Form 526, the "Daily Flight Inspection Record" which each student must fill out at least once during his training. Part I—Line Inspection, covers the six general headings listed above on the maintenance record, plus an additional item, warming up. In all, 53 points are covered. This inspection is not made by the student alone, but he is accompanied by a certified mechanic. The inspection usually requires at least an hour

Part II of the form is the Servicing Record and includes the amounts of gasoline and oil used by the airplane throughout the day. Part III—Report After Flight—is a one-line item filled in by each student using the airplane that day, and gives his air time, aver-



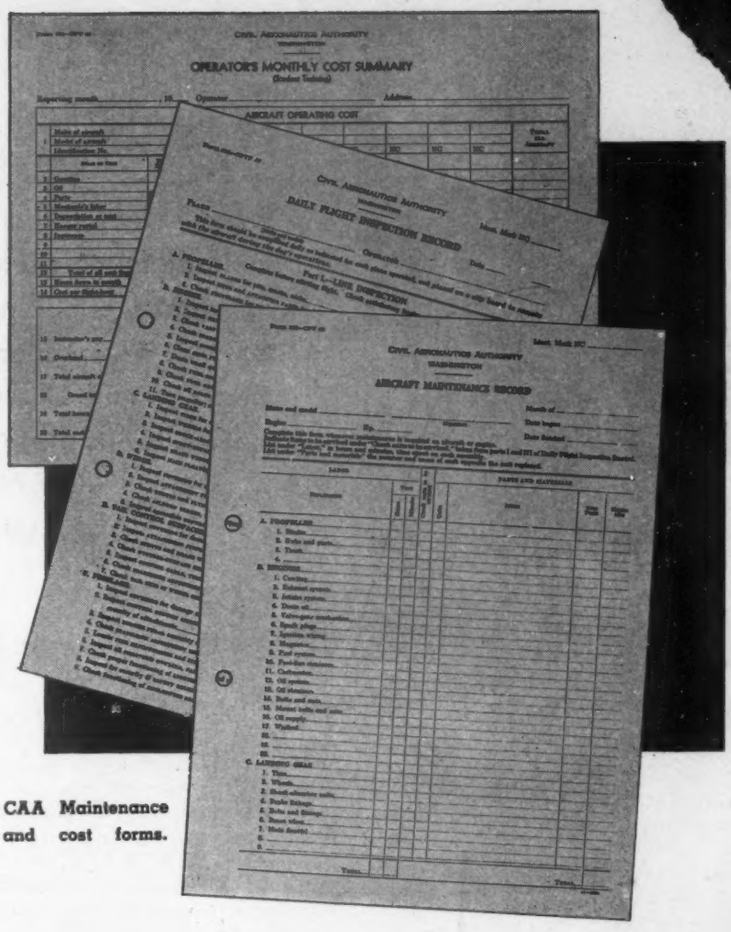
age r.p.m., oil pressure, oil temperature, and a place for remarks concerning defects in the ship which the student feels should be remedied. There is also space for summaries of the day's operations, gas and oil used, total flying time of the ship, time during the month, and the rate per hour of gas and oil consumption. The form becomes part of the student's permanent record, and each student must have one in his book.

This form is intended by C.A.A. as strictly educational for the student. It is not to be interpreted by the operator as a maintenance form. However, in actual practice, it has served to improve maintenance practices with a number of operators. The work of mechanics is being checked by a group of alert students who are naturally critical of the ship they expect to fly. True, the students were beginners and some didn't know one airplane part from another. However, mechanics have taken greater pride in their work than formerly, and since during inspections, they are the boss over men who often have more education but less mechanical experience, they are enjoying serving as instructors. This stimulates them to turn out a good job.

With these two forms the mechanic has a guide to follow. He is not apt to overlook some small, but important detail. He signs for his work and consequently takes full responsibility for it. Students are taught that they are not sissies if they point out parts of the airplane that do not seem to be functioning properly.

If ten students are assigned to a ship it means that at least ten careful line inspections are given during training. But some students make three or four such inspections during their course. It is safe to say that few groups of ships outside the airlines have been scrutinized as often as are these light planes used for civilian training.

Maintenance of the training planes is coming closer and closer to the airline idea of preventive maintenance. Parts are inspected, and replaced if necessary, before they may cause trouble. Maintenance is an every-day affair rather than something that takes place after a ship breaks down.



CAA Maintenance and cost forms.

In addition to the paper records, many operators use a large blackboard with a visual record of each ship. Flying time is chalked up where it is quickly seen. Time for inspections is indicated and mechanics are not likely to overlook them.

With 1,000 airplanes being flown almost daily, and with C.A.A. men from the Private Flying Development Division in close touch with the operators, any weaknesses from poor design or materials comes to light rapidly. C.A.A. acts as a liaison agency between the operator and the factory and complaints can be quickly remedied.

Another factor making for careful maintenance is that every operator is on his toes to make a perfect record. He realizes that the program is experimental, that it is the biggest flight program of its kind in the world, and that if it is to be a success the safety record must be excellent. Good flying schools have always been jealous of their safety records, and the best operators

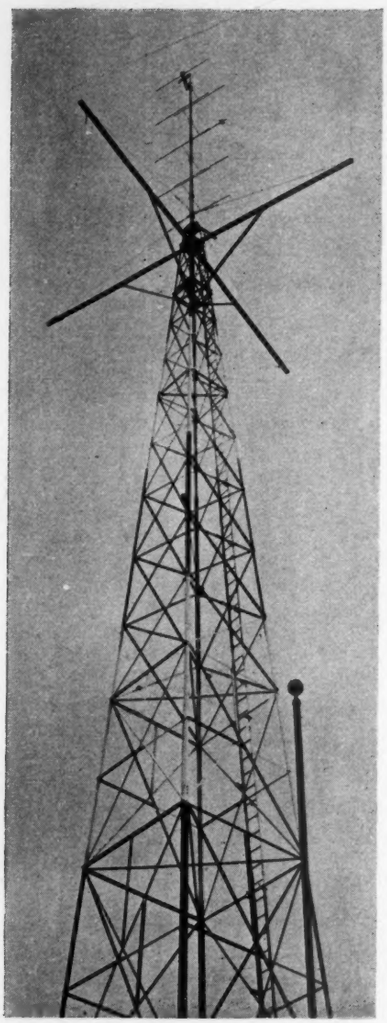
(Turn to page 122)

UHF

A continuation of a basic article on the present and future of short-wave communication and navigation which was begun in our January issue. It was prepared originally for the Vienna meeting of the Lilienthal Gesellschaft which was to have taken place last October.

By W. E. Jackson
Chief, Radio Development Section, C.A.A.

PART II

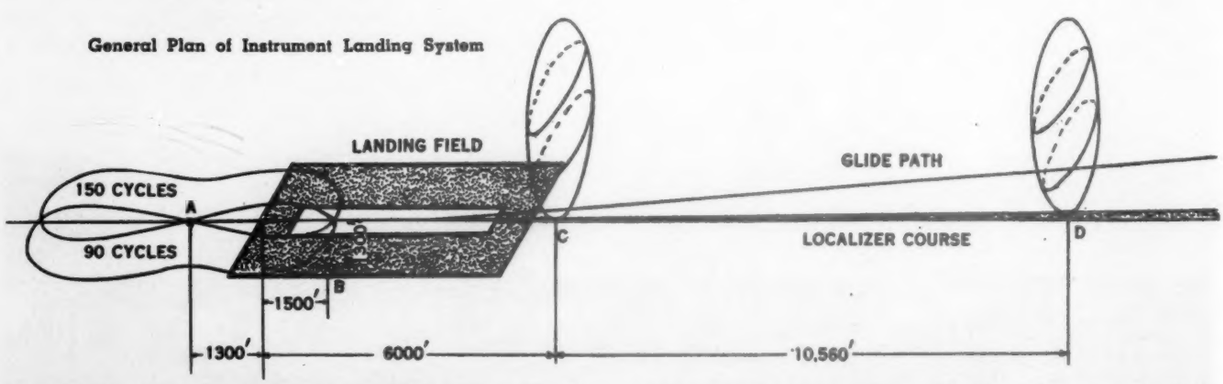


Transmitting and Receiving Antennas Used in Experimental Radio Teletype Installation

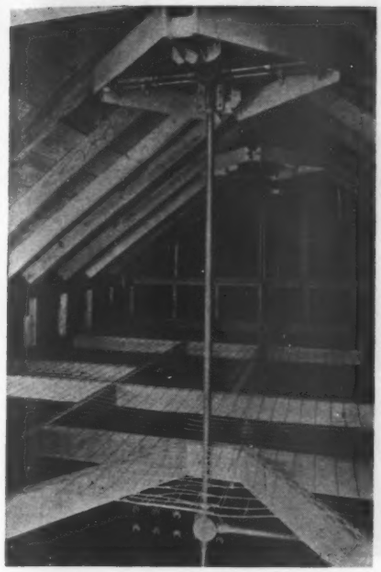
DURING the early period of development and use of directional radio facilities as an aid to air navigation, it became apparent that some adaptation of the same ideas could be utilized to assist aircraft in landing under conditions of restricted or zero visibility. The adoption of instrument navigation for scheduled operation has emphasized the need for an instrument landing system which now is considered a requisite of major importance.

Development work was started by the Government in 1919, but it was not until 1929 that the first experimental landing system was installed and tested. This system employed low-frequency radio range and marker beacons. Lieut. J. H. Doolittle made the first known successful instrument landing on September 24, 1929. During the same year, the use of ultra-high frequencies for a constant-intensity glide path was conceived and by 1931 successful landings were being made with the aid of a localizer, glide path, and marker beacons. During the following years, an extensive program of tests and improvements were carried on by the major airlines, several radio manufacturing companies, and the Government. The result of this development work has been to combine the superior principles of each system into an experimental installation which is now being thoroughly tested at the Civil Aeronautics Authority Experimental Station located at Indianapolis, Indiana. Results of these tests have been sufficiently encouraging to warrant commencement of work on a program calling for the installation of this landing system at several major air-

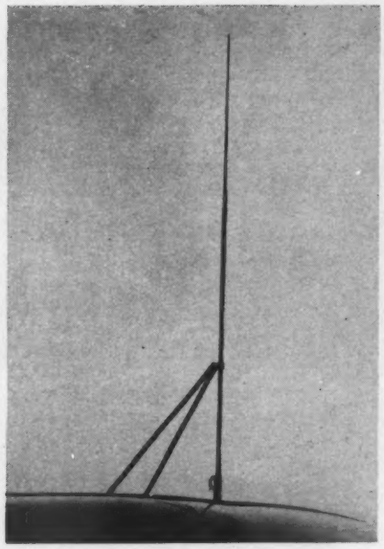
General Plan of Instrument Landing System



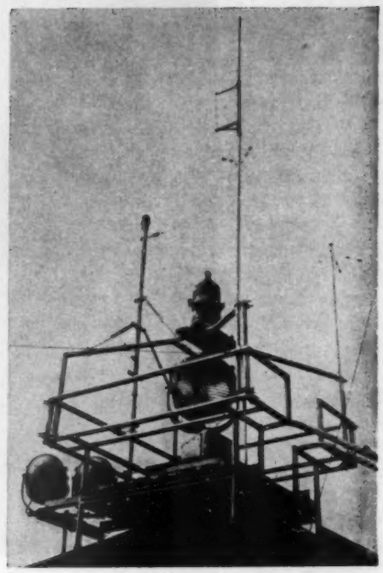
A = 109.9 Mc. visual runway localizer modulated at 90 cycles and 150 cycles. B = 93.9 Mc. glide path transmitter modulated at 60 cycles. C = Mc. inner marker modulated at 1300 cycles. D = 75 Mc. outer marker modulated at 400 cyles.



Localizer Antenna Installation at Indianapolis, Ind.



141.78 Mc Aircraft Transmitting Antenna



125 Mc Airport Traffic Control Antenna

ports within continental United States.

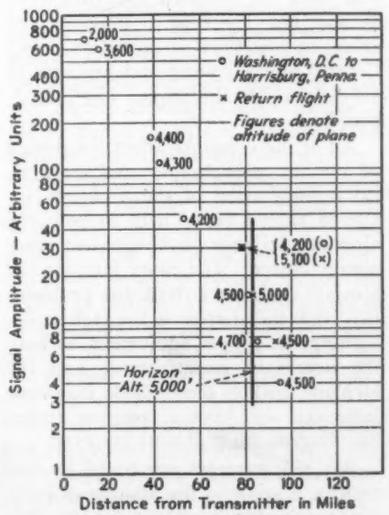
The complete experimental landing system as installed at the Indianapolis Airport provides permanent facilities for landing in four directions. Each facility is comprised of three fundamental elements consisting of a runway localizer which provides a range course for horizontal guidance, a glide path or landing beam which provides the path of descent, and two marker beacons for indicating the progress of approach to the landing field.

The runway localizer comprises a crystal-controlled transmitter unit operating on a freqency of 109.9 megacycles with an antenna output of 150 watts divided equally into two output circuits each modulated at 95 per cent with one circuit having a modulation frequency of 90 cycles and the other 150 cycles. The localizer antenna system consists of five horizontal loop radiators one-half wavelength above a counter-poise. The transmitter and antennas are located in a house 1300 feet beyond the end of the runway. The antenna produces a range course extending through the center of the runway by providing two overlapping elliptical space patterns each having the same radio frequency, but modulated at 90 and 150 cycles respectively which permits the operation of a visual indicator.

The glide path equipment comprises a crystal-controlled transmitter unit operating on a frequency of 93.9 megacycles with an antenna output of 300 watts and 100 per cent modulated with a frequency of 60 cycles. The antenna system consists of two horizontal loops excited 180 degrees out of phase and spaced approximately one wavelength apart. The currents in the two loops have a ratio of about 2.7 to one. The transmitter and antenna are located in a house 1300 feet to the side of the runway and 2000 feet from the far end of the runway. This antenna produces a straight line glide path from an altitude of 600 feet to the runway by providing a horizontally polarized directional space pattern which is distorted to give a straight line glide path.

The inner and outer marker equipments required for each of the four landing courses are located along the axis of the runways. The inner marker is located at the edge of the field and the outer marker is located two miles from the inner marker. Each marker comprises a crystal-controlled transmitter operating on a frequency of 75 megacycles with an antenna output of 5 watts and 100 per cent modulated. The outer marker is modulated with 400 cycles and is continuously keyed with dashes while the inner marker is modulated with 1300 cycles and is continuously keyed with dots. The outer marker has a radiating system consisting of an antenna array of two horizontal collinear cophased half-wavelength elements located one-quarter wavelength above a 20 x 20 foot steel counterpoise which is located about one-half wavelength above the ground level. The radiating system of the inner marker is identical to the outer marker except that the antenna array is located one-eighth wavelength above the counterpoise which is located only two feet above the ground level. This is necessary to avoid creating a flying hazard near the field. A pair of concentric transmission lines connect the antennas to the transmitter. The space pattern produced by either marker is elliptically shaped with the major axis in the plane perpendicular to the antennas and the minor axis in the plane of the antennas. The major axis is greater than three times the width of the minor axis in the plane parallel to the ground. The markers are installed with the major axis perpendicular to the landing beams. Aircraft following the straight-line glide path pass over the outer marker at

(*Turn to page 125*)



Attenuation of 141.78 Mc Airplane Transmission

Cabin Superchargers

With the advent of sub-stratosphere flying there came many problems which affect the design of superchargers for pressurized cabins

By David Gregg
Chief Research Engineer, Eclipse Aviation Division, Bendix Aviation Corp.

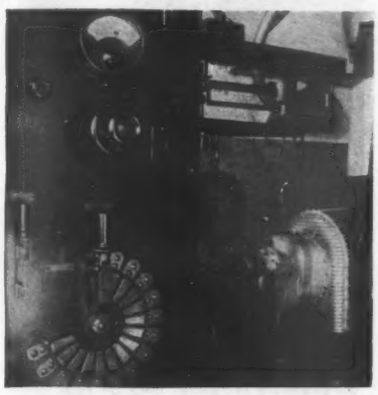
MOTHER NATURE seems to have been one step behind the engineers when the idea of taking a plane into the sub-stratosphere came around. Aerodynamically and structurally planes had been built to get above 20,000 ft. but no one was able to put his finger on a pilot that was properly stress analyzed to go along with it unaided. Thus came the birth of supercharged cabins and along with them the problem of some means to do the supercharging.

Aside from the structural design of the cabin itself, and those features which pertain particularly to the aircraft, the designer's principal worry in this connection is the problem of specifying the size, type, and operating characteristics of a cabin supercharger so that the accessory manufacturer can provide a unit which will satisfactorily meet operating requirements. The designer must take into consideration five basic factors affecting the selection and design of the cabin supercharging equipment: (1) The air requirements, either in terms of mass flow, or cubic feet of air per minute at a specified pressure and temperature. The altitude pressure at which the cabin is to be maintained, and the maximum altitude at which cabin pressure is to be maintained. (2) The type of cabin supercharger which will best meet the specified operating conditions. (3) The type of supercharger drive, and method of operation. (4) Control of the volume and pressure of air delivered to the cabin. (5) Soundproofing.

All of these factors affect the design of a cabin supercharger, and a practical consideration of the problems involved should be of help to both the aircraft designer and the accessory manufacturer. The more familiar the aircraft designer is with the problems involved, the simpler is the task of designing the proper equipment, as both the accessory manufacturer and the airplane maker then speak the same language, and have a common understanding of the problems involved.

Air requirements are based on two factors, a study of the amount of fresh air required per passenger per unit time in order to provide both comfort and adequate ventilation, and the pressure which is maintained in the cabin, based on Civil Aeronautics Authority requirements and airline operating experience. Many studies have been made to determine the volume of air required. The Army Air Corps at Wright Field has made a careful and extensive study of this problem and the effect of varying amounts of air on health and comfort. Very roughly speaking, it appears that slightly over 1 cu.ft. of air per passenger per minute is necessary in order to maintain a uniform CO_2 content. Five cubic feet per passenger per minute will provide reasonable comfort provided the air in the cabin is recirculated, and 10 cu.ft. per passenger per minute will take care of both comfort and adequate ventilation without the necessity of recirculating the air in the cabin. The pressure maintained in the cabin, and the altitude at which this pressure must be maintained, has a very important bearing on the design of the cabin supercharger and the type which will most effectively meet the operating conditions. At the present time there is little uniformity of opinion regarding the desired cabin altitude pressure; proposed designs range all the way from an altitude pressure of 6,000 ft. to an altitude pressure of 12,000 ft. The altitudes at which these pressures must be maintained vary from 18,000 ft. to 35,000 ft. The pressure ratios necessary to maintain these pressures vary from as low as 1.35 to 1 to a high of 3 to 1. It is obvious, from the standpoint of weight and horsepower, that the highest altitude pressure in the cabin and the lowest altitude at which this pressure must be maintained, are desirable

The air requirements should be based on the number of passengers and crew carried, and the proposed altitude for routine flying—any increase in requirements beyond these limits will increase the weight, bulk, power required, and cost of a cabin supercharger installation. Cabin leakage, provided it does not exceed the air requirements for passengers and crew, will not necessarily increase the required amount of air delivered to the cabin. Emergency operation for short periods at higher than rated altitudes—to avoid local storm heads, for example—can ordinarly be taken care of without increasing the specified requirements for the cabin supercharger. For example, if centrifugal superchargers are used, the cruising r.p.m. of the engines may be increased to provide a higher drive speed to the supercharger and the pressure ratio of the air delivered to the cabin will increase roughly with the square of the drive speed, and hence maintain the rated cabin pressure at higher than rated altitudes. With a Roots blower the same result can be produced by throttling the air discharge from the cabin; the blower will then maintain substantially the same mass flow by supplying a lesser amount of air at a higher pressure. In any event, the maximum altitude at which rated cabin altitude can be maintained will be limited by the permissible pressure differential, and by the safety valve.



A dynamometer test set-up for testing a centrifugal type accessory supercharger (at the right). The air enters the supercharger through the square vertical tube at the right.

One type of supercharger that might be applicable to cabin supercharging is the centrifugal type. The driving power is obtained through the shaft at the upper left. The supercharged air is expelled through the vent at the lower right.

The exact air requirements again depend on the proposed type of operation. If the airplane in question has two engines and a cabin supercharger is provided on each engine, the required air capacity may be divided between the two superchargers, for if one engine fails and the airplane is flown on a single engine, the r.p.m. of that engine will immediately increase from a cruising r.p.m. say of 1,600 or 1,800 to some higher r.p.m. This has the immediate effect of increasing the amount of air delivered. At the same time the altitude that can be maintained with a single engine may be less than the normal flight altitude with two engines, which would again increase the actual supply of air to the cabin as the operating characteristics of either a Roots or centrifugal supercharger are such that they will deliver a larger volume of air against a smaller pressure. In a four-engine airplane with cabin superchargers on two of the engines, it would probably be desirable to provide recirculation of the air in the cabin as an emergency measure. For example, if two cabin superchargers together are capable of delivering 10 cu.ft. per minute per passenger, and one engine driving a supercharger is placed out of operation, the remaining volume on a four-engine airplane, which has been designed to maintain its flight altitude on three engines, would be 5 cu.ft. per minute per passenger. This would be perfectly adequate and would provide a reasonable degree of comfort for the passengers if recirculation of the cabin air was started immediately upon failure of one engine. By operating in this manner the cabin superchargers can be made as small and light as possible, and the power absorbed by the cabin superchargers can, therefore, be kept to a minimum.

Based on practical design considerations, a centrifugal type of cabin supercharger forms a simple and compact unit for compression ratios up to about 1.4 to 1 for a single stage, and 2 to 1 for two stages. The reason for these limitations are described later in this article.

Air volume presents little problem in a centrifugal supercharger. It is easy to supply practically any amount of air within reason by increasing the inlet area to the impeller and the width of the impeller. Bulk and weight are not increased in proportion to air supply. Where compression ratios as high as 3 to 1 are required of a centrifugal supercharger, the impeller diameter or impeller speeds must be quite large even with two stages, and as the required pressure must be maintained at cruising speed, severe loads are produced at take-off and under conditions of single-engine operation. For small amounts or air and in particular, small amounts of air at high presure ratios, a Roots blower affords some very definite advantages. Where the cubic feet of free air supplied is between 100 and 200 cu.ft. per minute, the bulk of the Roots blower compares quite favorably with that of the centrifugal. In a Roots blower, in spite of a large compression ratio, the pressure difference between the inlet and outlet of the blower is relatively small and for the maximum ratio approaches 7½ to 8 psi:

Methods of power

The ideal method of drive is some form of variable speed transmission such that the blower speed will be just sufficient to meet operating requirements. A drive of this kind involves the minimum horsepower and least severe operating conditions. At the present time, the horsepower involved in cabin superchargers for present and proposed designs is between 8 to 20 hp. A variable speed hydraulic drive would be very desirable, provided the weight were within reach. Unfortunately drives of this type are still in the experimental stage and are not available for practical application. The present available methods are by a drive-shaft from the power take-off of the main engine, from a gear box driven from the power take-off, or by an auxiliary engine. For military airplanes with crews of ten people or less, either hydraulic or electric drives are a possibility and may offer an acceptable solution. For the average commercial or military airplane, however, the most practical drive at the present time is a mechanical power take-off direct from a main engine. This involves a change in drive speeds be-

(Turn to page 126)

Quantity Production of Small Radial Engines

Producers of airplane engines are working overtime to prevent a bottleneck from developing. Here is the story of the reorganized Kinner Motors, and its production of 150 engines a month.

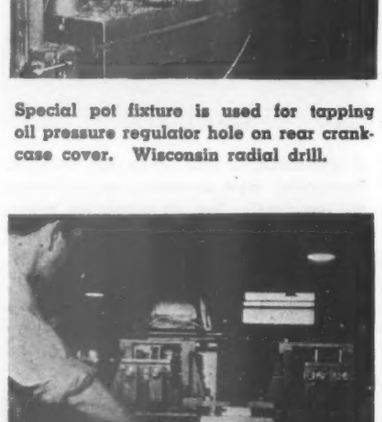
WAR ORDERS and the rapid expansion of private flying have made mass production of small aircraft engines necessary. But mass production in the aircraft engine field is quite different than in the automotive field. We must think and work in terms of less than 500 engines per month, at the most, where automobile men produce thousands of units a day. Because of this limited production we cannot utilize expensive highly specialized automatic production machinery to any appreciable extent, nor can we resort to the elaborate tooling set-ups common in the automotive field. Due to the rapid development in engine design, and the required close inspection and material control, we must employ general purpose machine tools of precision type. With relatively limited tooling we must achieve a relatively high rate of production, and this must be done without sacrifice of engine performance or reliability.

Kinner Motors, Inc., recently received the largest single aircraft engine order ever placed on the Pacific Coast, calling for 509 engines to be installed in Candian-built Fleet training planes. This business, in addition to other engine orders received from foreign and domestic customers, has required immediate acceleration of production on three types of Kinner engines now in production. These are the K-5 engine of 100 h.p., the B-5, 125 h.p. engine, and the R-5 engine of 160 h.p. We are fortunate in that these three engines are of quite similar type, materially simplifying flow of work through the plant as well as final assembly operations.

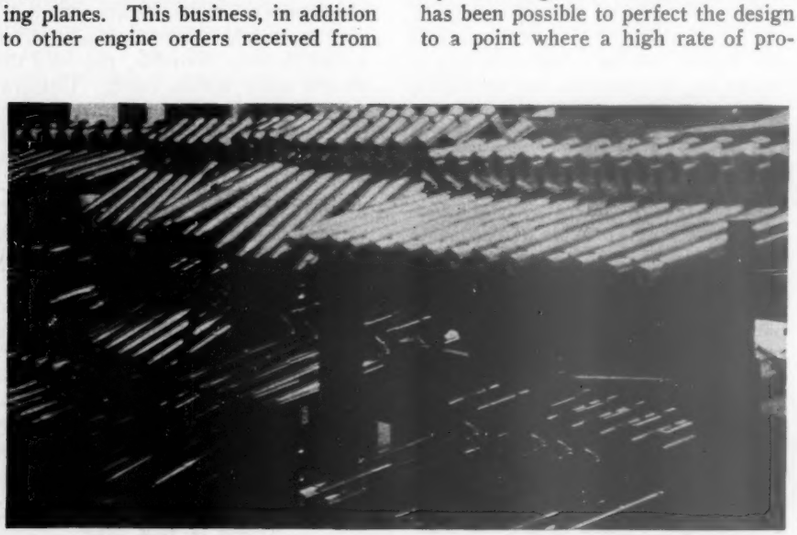
Kinner Motors, Inc., although an entirely new company which recently purchased all assets of the old Kinner Airplane and Motor Corp., is able to make full use of the original engine designs and tooling which were developed from the first for quantity production. And while the executive personnel of the new company represents a complete "new deal", many of the original machinists and shop men have been available to give the benefit of their experience in meeting the current production problem. Kinner engines are favorably known throughout the world, having flown more than 100,000,000 miles in many types of aircraft and in practically every country. Through such extensive use it has been possible to perfect the design to a point where a high rate of pro-

Moline Hole Hog drill press, drilling both ends on two master rods. The bases have previously been faced.

Special pot fixture is used for tapping oil pressure regulator hole on rear crankcase cover. Wisconsin radial drill.



Milling master rod big ends before paring for drilling half holes. Operator sets one rod as he mills another.



More than 100 Kinner crankshafts going through the shop on the present production run. Wood racks mounted on casters are used.

A line-up of Kinner engine crankcases going through the shop. All parts are carried on wood racks for ease in handling and to reduce scratching. Milwaukee mill in background.

Simultaneously drilling twelve holes in a front crankcase cover with a Natco multiple spindle drill.

duction can be undertaken without the necessity of design changes of anything but the most detailed sort during any run of parts. The present Kinner company has completely modernized the plant and equipment, as well as the design of the engines, laying special stress on reliability and precision, so that present maximum production is set at about 150 engines per month. Plans are being made to step up production, if necessary, to 250 engines per month.

To achieve all the required results in engine production; precision, interchangeability, reliability, performance, and maximum rate of production with equipment available, it has been necessary to put volume of production last. Faced with such handicaps, the responsibility for successfully achieving a high order of production efficiency has largely fallen on the engineering department. The design of every part has had to be examined to find out how it could be simplified or speeded up without sacrificing any of the points mentioned above.

How it is possible to accomplish this may be illustrated by referring to the general design of the engine, and some of the machine operations used in translating that design to the finished product. The Kinner engines of K-5, B-5 and R-5 series are all five cylinder radial models of conventional design and construction. For purposes of illustration we will confine ourselves to consideration of the B-5 engine of 125 h.p. To simplify production of this engine we carefully studied the three major structural elements, the main crankcase, crankshaft, and master rod. It was found advantageous to manufacture the main case in one piece, which materially simplifies machining and assembly. The crankshaft is also forged in one piece, except for the balance weights, and is carried on two plain bearings, one in the main case and the forward bearing in the detachable nose cover, which also carries the ball thrust bearing. Precision machining of the bearing mounts is assured by hand line reaming after preliminary machining and assembly of the nose section to the main case.

Preliminary machine work on the main case is done in a Bullard vertical turret lathe, the first cut being made on the forward face with the case held in a clamp fixture. Thereafter all machining is done in locating fixtures. Joints for the front and rear crankcase covers are faced in the Bullard, the rear main bearing support is faced at both ends and bored.

Design of the cylinder base, valve tappet ledge and intake pipe flange is such as to permit these surfaces to be milled in a single operation for each cylinder station through use of a special double milling head on a Milwaukee horizontal mill. The case is mounted in a radial fixture which may be indexed accurately for each cylinder base cut, and for the oil sump pad facing operation, which is at the same level as the cylinder base supports.

One milling cutter faces the cylinder base mount while the second faces the

(*Turn to page 115*)

By Gunnar Edenquist

Chief Engineer
Kinner Motors, Inc.

"American" Adds Big ...again Safety-

25 MILLION PLANE MILES TO GO! American "Flagships" like these cover 6,775 miles of route, serving 57 major cities of the nation with fast schedules and luxurious service every mile of the way. In 1940 still more of these Goodrich-equipped Flagships will take their places in the ever-growing line-up.

"NO LOITERING" FOR ICE. American Airlines' propellers are kept free of ice by the Goodrich development at the left. This special "spinner" and "slinger ring" assembly gives the blades a continuous bath in an ice-defying solution during winter and high altitude flying.

★

WHEN WINTER COMES. Wing edges of American's Flagships get the protective covering of these "DE-ICERS." Automatic inflation and deflation of longitudinal tubes loosens and lifts the ice so that the wind can sweep the wing edge clean.

Fleet of Flagships
Equipped by Goodrich!

59% Increase in Luxury Flagships during 1940 adds to Goodrich Leadership in Tires, DE-ICERS and other Vital Features of Modern Air Transportation!

"STAND TO" FOR INSPECTION. These huge low pressure Silvertowns that give American's planes safe, smooth landings come in for their share of the rigid inspections that govern all American Airlines' operations.

"IT PAYS TO FLY" says the aviation industry. And American Airlines is meeting this challenge by increasing its 1940 fleet to record size . . . with new units "on order" that will make its fleet fifty-nine percent bigger!

It is a matter of pride with Goodrich that during American Airlines' phenomenal growth it has seen Goodrich Aviation Products become integral with this air line's big scale operations. The fact is that Goodrich Airplane Silvertowns have given the "Flagships" safe, smooth landings for many years. And Goodrich DE-ICERS have protected thousands of "American's" continent-spanning flights in winter.

Goodrich is proud, too, that it will continue in this envied position in 1940. It is one more example that Goodrich Aviation Products measure up to the greatest needs of the aviation industry — where it supplies not only tires and DE-ICERS but the new Goodrich E.T.* Brakes and over 40 other aviation products for the leading pilots, air lines and plane makers. Write The B. F. Goodrich Co., Aeronautical Division, Akron, Ohio, for complete information about Goodrich Aviation Products.

*Goodrich Expander Tube Brakes are manufactured under license and sold by Hayes Industries, Inc., Jackson, Mich., and Bendix Aviation Corp., South Bend, Ind.

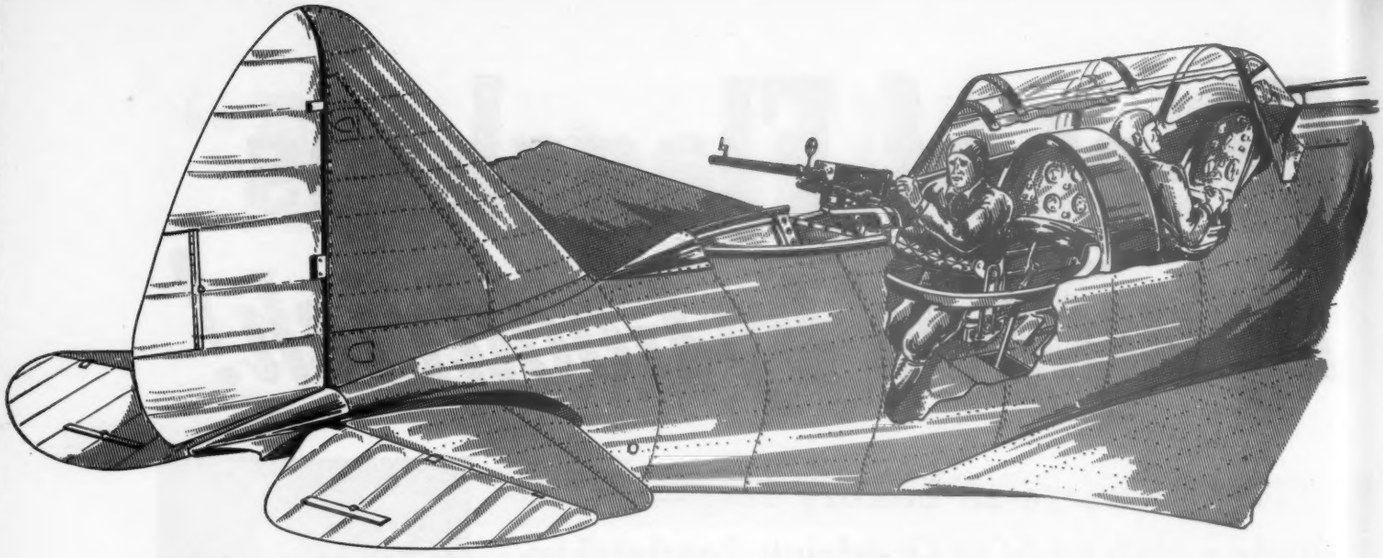
IT PAYS TO FLY

and it pays to take off and land on Goodrich Airplane Silvertowns >>>>> the safest airplane tires ever built

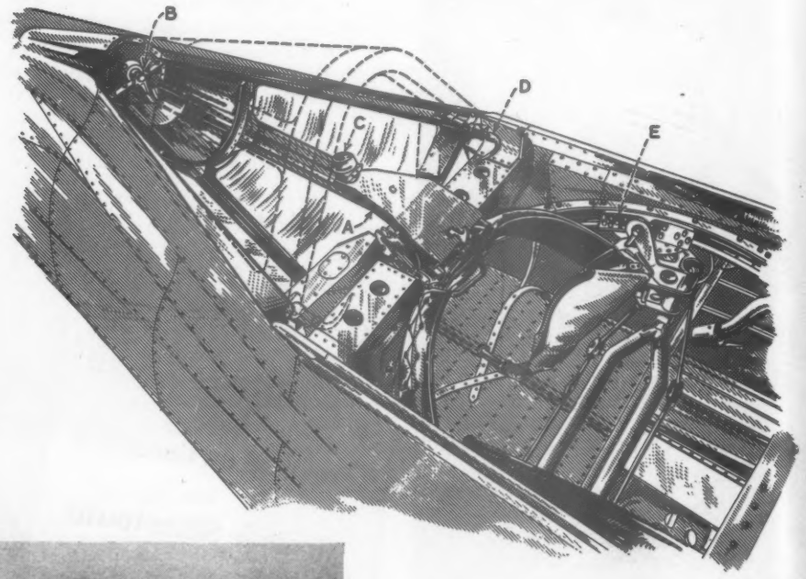
Goodrich *Airplane* Silvertowns

THE SAFEST AIRPLANE TIRE EVER BUILT

Over 40 Rubber Products for Airplanes — including Tires — Tail Wheels — Abrasion Shoes — DE-ICERS — Matting — Rubber Hose — Grommets — Shock Absorber Cord — A Complete Line of Rubber Aeronautical Accessories.

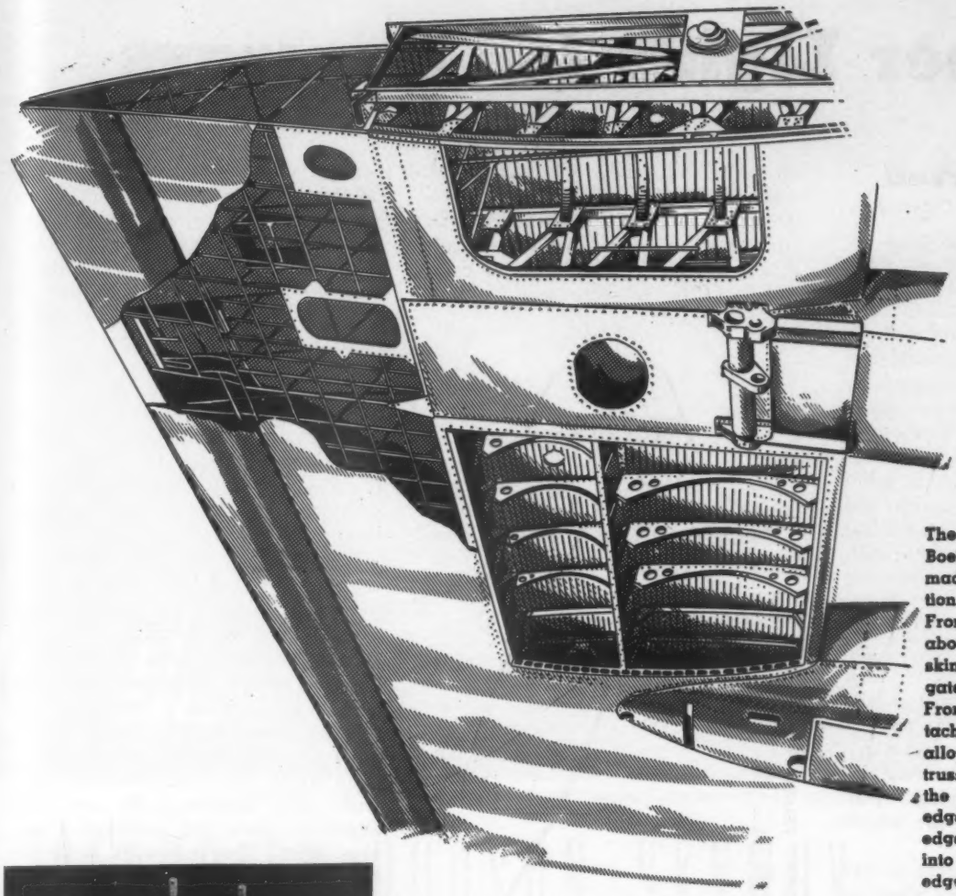


When two cockpits are placed conveniently in a ship the size of a single seater pursuit it's time to peel off some of the covering and see what was done. The rear gunner's position of the Republic 2PA directly aft of the pilot is such that when operating the gun he sits on a carriage hung from slides in the gunner's ring. The gunner's ring is supported structurally by a bulkhead at the center of the rear cockpit and by the stringers at the edge. The fuselage structure is of standard construction consisting of continuous longitudinal stringers and former rings, the covering being of the stressed skin type. The cockpits are completely enclosed by canopies, which may be locked in any one of several positions. To operate the flexible rear gun, the rear portion of the sliding canopy is slid forward, and the gun turret rotated about the gun, automatically unlocking it from its stowed position. The gun is completely clear of the fuselage and permits 180 degrees horizontal and 70 degrees vertical fire, while the gunner is seated, and full coverage from stabilizer to wing when the gunner is kneeling. The surface controls and throttle and ignition emergency switch are duplicated in the rear cockpit.

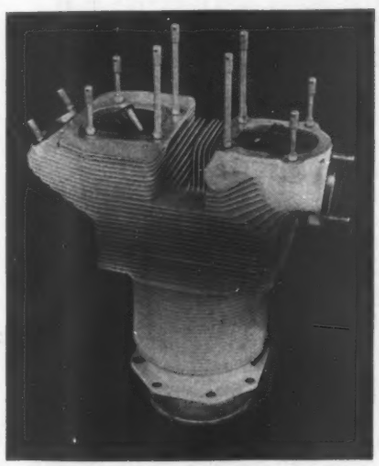


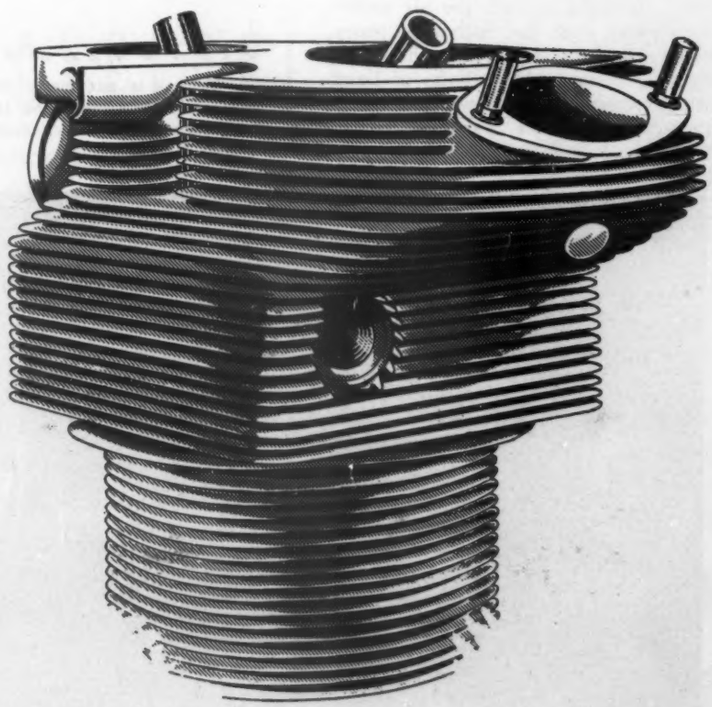
Right: The gun turret when rotated for the firing of the rear gun swings down into a well in the fuselage. This is done by gripping handle D, which is on the opposite side from that shown when the turret is closed, and revolving the turret, which is hinged at A and B. The gun is mounted at point C, a bracket connected to the seat, and the muzzle clips in the bracket below B when not in use. E is the slide in the gunner's ring to which the seat is attached. Thus when the seat is moved the gun remains in an accurate firing position for the rear pilot.

Left: Republic "Guardsman"—Model 2PA—24 of which are being sold to Sweden.



The outer wing panel of the Boeing B-17B Flying Fortress is made as a unit in the construction jig with nacelles included. From the leading edge back to about 60 percent of the chord the skin is reinforced with corrugated aluminum alloy sheet. From there back the skin is attached to built up aluminum alloy ribs. Three spars, of the truss type are used in the wing, the front one being at the right edge in the drawing (leading edge not attached). The flap fits into the well along the trailing edge.





One of the outstanding advancements aiding engine developments has been the ability to cast thin fins on cylinder heads. The fins on the Ranger engine aluminum alloy cylinder shown have more than doubled the fin area previously used. The fins around the exhaust port, necessary for efficient cooling, extend out so far as to give the cylinder head a square shape when viewed from the top. Both vertical and horizontal fins are employed between the intake and exhaust ports with the uppermost fin on the intake port curved to act as a baffle. The fins around the spark plug hole are spaced unusually close due to the development of a new type spark plug that does not require a hard metal seat fixed in the head.

Amber Lights for Runways

By W. C. Norvell
Westinghouse Lighting Division

INSTRUMENT landings are commonplace; yet even with recent developments airlines use them as little as possible. In a true "blind landing" the ship is "flown into the ground" and sometimes contacts with a considerable jar—not bothersome to the experienced pilot but a danger signal to the airlines who must recognize any passenger inhibitions leading to the belief that everything is not smooth and safe. In view of this, the best method of bringing a plane in under conditions of low visibility is a combination of instrument and contact flying. Radio should be used to bring the plane up to the boundary of the field and in position for landing. At that point, it is advisable to give the pilot some visual indication of the runway in front of him so that he can make a conventional three-point landing instead of maintaining flying speed along the glide path until the wheels touch the ground.

In the past, marker lights of the flush type, installed 100 feet apart on either side of the runway, threw beams straight up into the air under the theory that the incoming plane could land between these shafts of light. However, these shafts of light were invisible in clear weather when there were no dust particles in the air to reflect the light. In thick weather, the shafts of light were visible but a short distance when viewed from the angle of the plane's approach. As radio beams became commonplace, pilots were not so concerned with the appearance of the field from directly above, but rather where the runway was located with relation to the approach beam. Thus, the whole practice of runway lighting was revolutionized to supplement instrument landing. The Civil Aeronautics Authority has standardized the lighting equipment for these low-visibility landing systems.

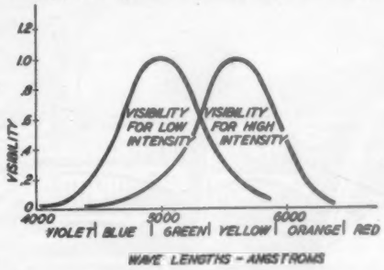


Figure 1. Visibility as a function of wave length of light

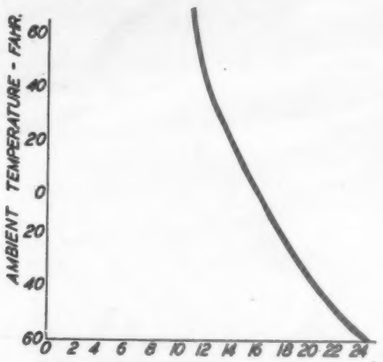


Figure 2. Time in minutes to attain 100 candlepower; time measured from first arc flashover (0 to 24 minutes).

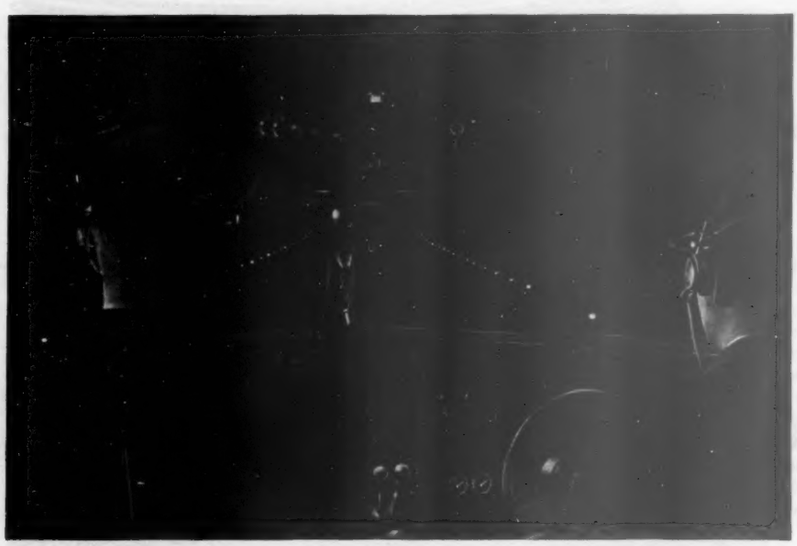
Since sodium vapor lamps are among the most efficient illuminants known, and because the yellow color is distinctive, there has been recently developed a sodium contact light primarily for the approach end of runways equipped with contact lights under conditions of low visibility.

Figure 1 shows how the sensitivity of the human eye shifts as the intensity of the light varies. For low intensities a wave length of 5,100 angstrom units (blue) produces the greatest stimulus. This tends to promote the use of the mercury-vapor lamp which has a characteristic spectrum lying between 4,500 and 5,000 angstrom units and produces a pale blue light. The test work with this light proved it excellent in this respect.

However, these lamps have one fault which prohibited their use—that is, when the lamp is momentarily turned off, it will not restrike until it has cooled. Thus a short interruption in the contact light circuit would darken the contact lights for several minutes. Last year the mercury capillary tube lamp was available commercially, but since this lamp must be water cooled, it is not readily adaptable. Although sodium is deficient in the emission range which is most sensitive to the human eye at low intensities, the golden light of sodium vapor is very distinctive and this more than compensates for the lack of emission in the maximum-sensitivity range. The light from sodium is monochromatic, and practically all the light is delivered in the single band of 5,900 angstrom units. Thus, it is possible to provide an efficient light source which would deliver a distinctive color easily distinguished from the usual lights on and near an airport.

The light emitted by sodium vapor, moreover, lies toward the longer wave lengths of the spectrum and is therefore subject to smaller refraction

(Turn to page 116)



How sodium-vapor runway lights look to the pilot of an incoming ship

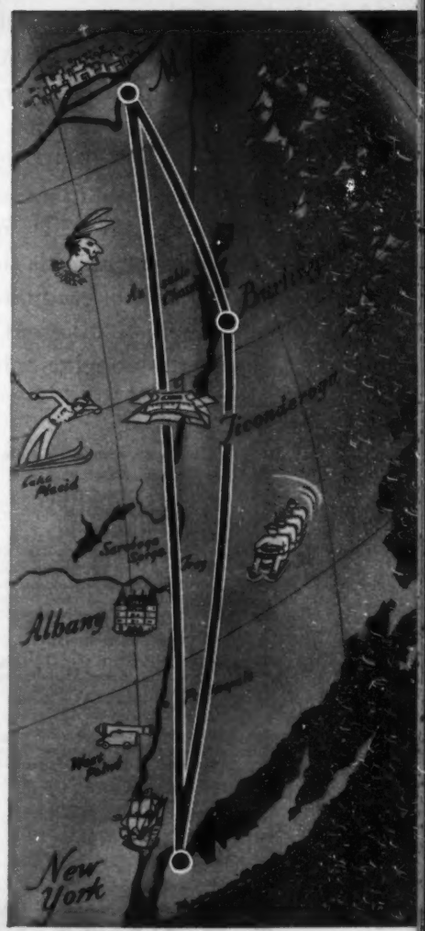
Up the

CANADIAN COLONIAL DOUGLAS OVER U. S. ARMY MILITARY ACADEMY AT WEST POINT

HENDRICK HUDSON SKYWAY *with* WRIGHT CYCLONES

High above the valley of the historic Hudson River, Canadian Colonial airliners today follow the course once sailed by Hendrick Hudson's *Half Moon* in futile search for a northwest passage to the Orient. This modern Skyway over the ancient river valley, where Rip Van Winkle, it is said, once heard the rumbling bowling-balls of Hudson's ghostly crew, now echoes to the roar of Wright Cyclones in Canadian Colonial Douglasses.

From New York to Montreal, Canadian Colonial passes over much historic and scenic country—the beautiful Hudson winding its way through Bear Mountain Pass . . . the U. S. Army Military Academy at West Point . . . New York's Playground, Saratoga Springs and the Adirondack area . . . Fort Ticonderoga and points in the Lake Champlain region made famous by Ethan Allen and his Green Mountain Boys—and across the border into Canada to link the important cities of two great nations. A fleet of new Wright Cyclone-powered Douglas DC-3's provides the same fast, luxurious accommodations which have made this engine-airplane combination the choice of major airlines all over the world.



WRIGHT AERONAUTICAL CORPORATION
Paterson New Jersey
A Division of Curtiss-Wright Corporation

WRIGHT *Aircraft* ENGINES

"Mr. Brown will see you"

BOEING SCHOOL OF AERONAUTICS

has an enviable placement record

The Boeing School of Aeronautics, founded and operated by United Air Lines, on the 890-acre Oakland, California, Airport, trains serious-minded young men for careers in the aviation industry.

Then it helps its young graduates to find positions. It does this without expense to the men or to the companies employing them. It, of course, cannot promise graduates jobs, but the records show that a very large proportion of all Boeing School graduates have found places—in 43 different organizations—and that Boeing School graduates make good!

Let the coupon below be your first step toward joining this outstanding group of graduates. Start to build an aviation career for yourself. Send the coupon.

HERE ARE 7 REASONS

why Boeing School prepares men for successful aviation careers:

1. A professional school, Government-approved in flying, mechanics, and as a repair station, equipped to the highest modern standards.
2. 11 thorough career courses—54 subjects.
3. 17 modern shops and laboratories.
4. 6 different types of training planes.
5. Instrument flying taught from the very start of the course, with the Link trainer.
6. 30 competent instructors and small classes for more personal teaching.
7. All-year flying weather.

ENROLLMENT PERIODS: JANUARY, APRIL, JULY, OCTOBER

BOEING SCHOOL OF AERONAUTICS

11 CAREER COURSES One specially designed to fit your chosen field of aviation. Check the course or courses you are most interested in:

Courses requiring High School only
- ☐ Airline Pilot and Engineering
- ☐ Airline Operations and Engineering
- ☐ Airline Mechanic and Operations
- ☐ Aeronautical Engineering
- ☐ Airline Mechanic
- ☐ Aircraft Sheet Metal
- ☐ Private Pilot

Courses requiring 2 yrs. of college
- ☐ Air Transport Engineering
- ☐ Airline Pilot Course

Courses for engineering graduates only
- ☐ Airline Technician ☐ Airline Meteorology

Courses requiring special training
- ☐ Special Airline Pilot ☐ Instrument Rating

NOTE: Link trainer & modern multi-motor instruction available to students in all courses.

Boeing School of Aeronautics
1040, Hangar No. 5, Airport, Oakland, California

GENTLEMEN: Please mail me—without charge—the Boeing School descriptive booklet containing complete information on the school and describing in detail the courses I have checked above.

Name.....

Street Address.....

City.....

State.....*Age*.....

Previous Schooling.....

UNITED AIR LINES

BOEING SCHOOL GRADS MAKE GOOD!

BOEING SCHOOL OF AERONAUTICS A DIVISION OF UNITED AIR LINES

Furious arguments may be heard in any aviation center when this question is raised. The author provides an answer and also suggests that airlines and military men get together on their fuel specifications.

WHICH Will It Be?

HIGH OCTANE GASOLINE or Safety Fuel

By J. R. MacGregor
Consulting Research Engineer
Standard Oil Company of California

RARELY can a group of individuals connected with the aviation industry be assembled for a discussion of their mutual problems without having such subjects as high octane gasoline, safety fuel and fuel injection considered. Because each of these subjects is relatively new, rumors are often clothed in the dignity of fact.

The two factors of aircraft fuels and suitably designed aircraft engines hold many of the answers to the important problem of economical air transportation. High octane fuels are on the market and their use in commercial service will soon be materially expanded. The constant brake-mean-effective-pressure method of operating engines has much to recommend it and its use will be extended rapidly as suitable adaptations become available. It results in greatly improved specific economy and a desirable reduction in engine noise. It also makes possible the economical use of a single high octane fuel at all times, with the obvious advantages resulting from the attendant simplification in construction, maintenance and operation.

High octane gasoline was first introduced by the Army Air Corps as the 100 octane grade. It was intended to meet requirements for a fuel that would permit higher specific power output in its new engines of higher compression ratio and/or manifold boost. The Army's experiment was successful and later commercial airlines asked for a similar fuel.

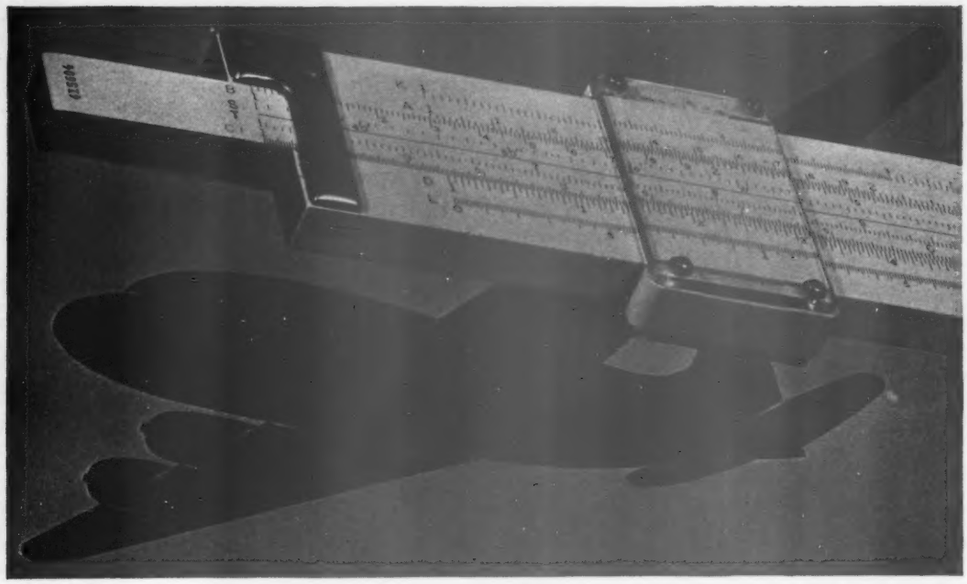
Military and commercial fuels of comparable grade differ in certain respects but the one characteristic that many believe to be common to both is the anti-knock value. This is not the case.

The Army and the airlines use different methods of rating fuels which cannot be correlated. Air Corps methods are based on the equivalency of similar temperatures when both the test and reference fuels are run in a particular type of single cylinder laboratory engine under test conditions. The airlines use the A.S.T.M.-C.F.R. method whereby the test and reference fuels are matched on the basis of detonation pressure wave magnitude, as indicated by the conventional bouncing pin. Early work by both methods indicated a certain correlation between ratings obtained by the two methods but this has since been proved in error. However, many still believe that 87 A.S.T.M. octane number is equal to 92 Army, and that 95 A.S.T.M. octane is equal to 100 Army.

There is not space to delve into the chemistry of the synthesis of the octanes or other hydrocarbons used in aviation gasoline. It will suffice to state that through individual and cooperative research on the isolation and synthesis of new hydrocarbons of high anti-knock value, fuels have been experimentally prepared which permit laboratory engines to develop power outputs much higher than are obtainable with 100 octane gasoline. Because of high production costs, such fuels cannot be put on the market until their advantages and possible limitations for present or future engines are carefully determined.

While the airlines have been commendably progressive, as is attested by the rapid improvement of their airplanes and engines, they have not given the most careful consideration to all phases of fuel specifications. Purchase specifications have been so

(Turn to page 98)



Let's Use Decimals!

By Curtis L. Bates
Chief Engineer
Aero Industries Technical Institute

SINCE engineers, mechanics, and the general public all think in terms of inches it appears that a proposal to use the metric system will meet opposition. However, a change-over from fractions to decimals of an inch can be made with very little effort and all the advantages of a decimal system can be gained by the move, plus the advantages of standardization of all dimensioning.

Actually there is nothing new in decimal dimensions since many such dimensions, especially on limits and tolerances, already appear on our aircraft drawings. In the following paragraphs are listed some of the more obvious advantages of a decimal system.

To an engineer the advantages of a decimal system need not be explained. All his slide rule computations must be carried out in decimals. The operation of converting calculated dimensions into fractions is needless and conducive to error. Probably in no other types of design are slide rule computations more extensively used than in the design of the modern airplane. For that matter, almost any calculation other than simple addition or subtraction is made in decimal form in preference to using unwieldy fractions. Further, all logarithms, trigonometric functions, and graphical charts are necessarily in decimal form.

Nearly every aeronautical engineer who has contact with the broader problems of design and production should welcome the change from fractions to decimals. The decimal system would greatly simplify our system of limits and tolerances. Of course tolerances are already given in decimals (as all dimensions should be given), but it seems that this could be carried much further. It would certainly be convenient to carry each decimal just far enough to indicate the degree of accuracy required, rather than adding additional numbers that only are confusing.

The decimal system would simplify the addition of dimensions. Thus errors in dimensioning should be less frequent and the checking of drawings would be facilitated. To most of us the addition of a mixed set of fractions, perhaps including eighths, sixteenths, 32nds, and 64ths, is a mathematical nuisance. In many cases decimals and fractions must be added together. This involves three steps—conversion to decimals, addition, and conversion to fractions again—whereas only the addition should be necessary. The decimal system, of course, eliminates these conversions and the attendant minor errors due to dropping of figures in the conversion and the impossibility of exact reconversion.

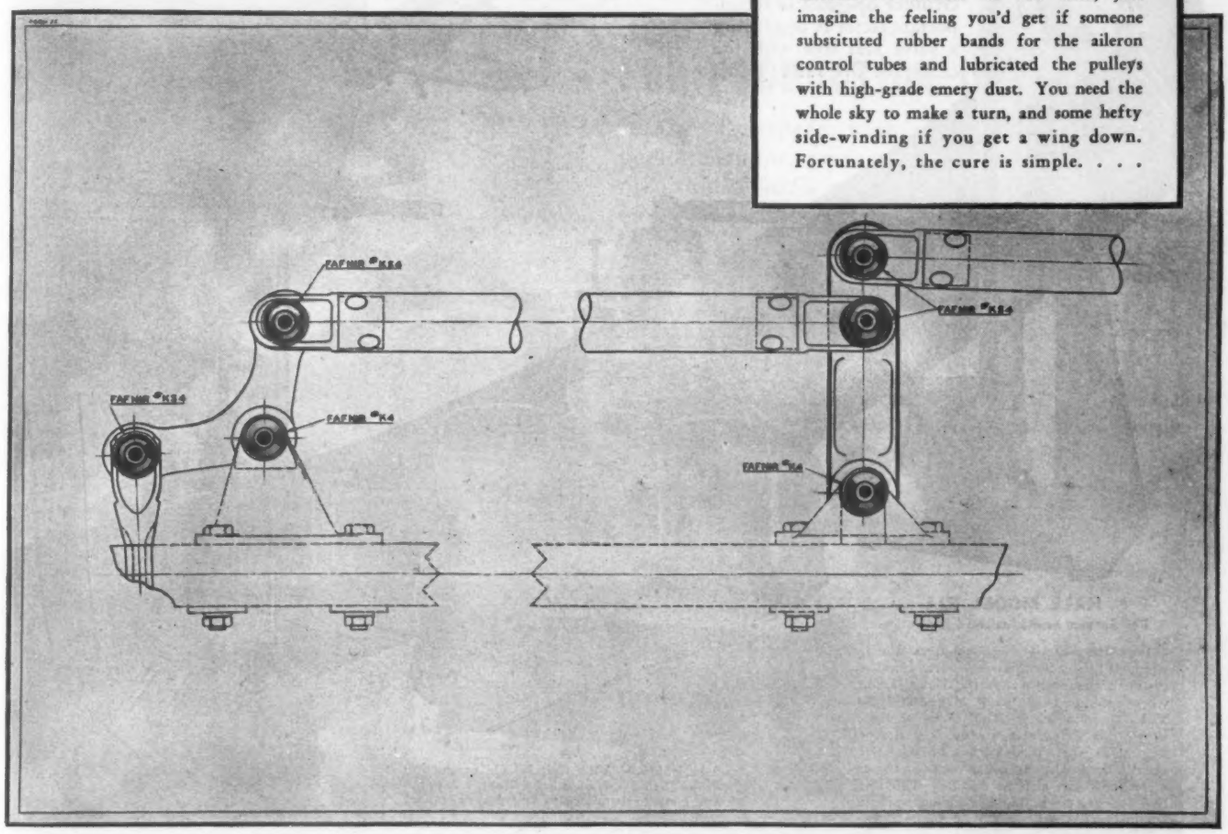
The decimal system would simplify template layout and similar operations in the shop, especially where these layouts are now made with decimal scales. In the case of templates for formed parts, for example, bend allowances must be calculated in decimals, usually giving odd fractional dimensions. For this reason the whole layout is usually calculated in decimal form. It does seem rather foolish that the original dimensions, probably calculated on the slide rule, must be converted to fractions for use on the drawing only to have the template department convert to decimals again.

The decimal system should be a forward step in simplifying shop practice. The present method of indicating drilled holes on drawings by both drill number and decimal equivalent indicates a trend toward decimals. If all drilled holes were indicated by decimals alone—and drills stocked in definite decimal sizes—it would not be necessary for the mechanic to carry a conversion chart to the tool crib when ordering a number drill, or to look for his decimal equivalents to "mike-up" a 5/64 in. drill.

Another indication of the trend toward decimals is the practise of indicating sheet metal thickness in thousandths rather than by gage number. Perhaps this has come about because of the confusion in gages—one for aluminum sheet, another for steel sheet, still another for tubing wall thickness. While we are about it, it might be advisable to clean house completely and set convenient decimal thickness standards for *all* sheet metal and tubing. The present confused listing of sizes is antiquated and not up to standard of aircraft practice.

Prescribe "Vitamins K4 and KS4" to cure "Bilious Banking"

If You've Ever Flown a ship troubled with "Bilious Banking" there's no need to describe the disease. If not—well, just imagine the feeling you'd get if someone substituted rubber bands for the aileron control tubes and lubricated the pulleys with high-grade emery dust. You need the whole sky to make a turn, and some hefty side-winding if you get a wing down. Fortunately, the cure is simple. . . .



FROM a leading aircraft manufacturer, we borrowed the tracing above. It shows how their engineers forever outlaw "Bilious Banking" by lettering the right Fafnir Aircraft Ball Bearings—right on the sketches! The push-pull tubes terminate in Fafnir KS series aircraft ball bearings, self-aligning to eliminate strains, sealed and lubricated for long life. The bell-crank and arm are mounted on rugged K series bearings that permit them to move accurately and friction-free at the pilot's slightest touch, through thousands of safe flying hours.

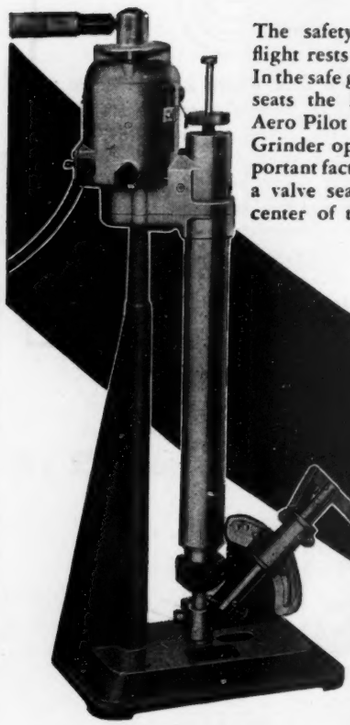
There's a Fafnir Aircraft Ball Bearing for every spot on every ship, with an unquestioned quality which you and all other aircraft builders have recognized for over ten years. Letter "Fafnir" right on your sketches, for easier, safer flying! The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

FAFNIR *Ball Bearings* { *For Aircraft Engines and Controls*

THE BALANCED LINE • MOST COMPLETE IN AMERICA

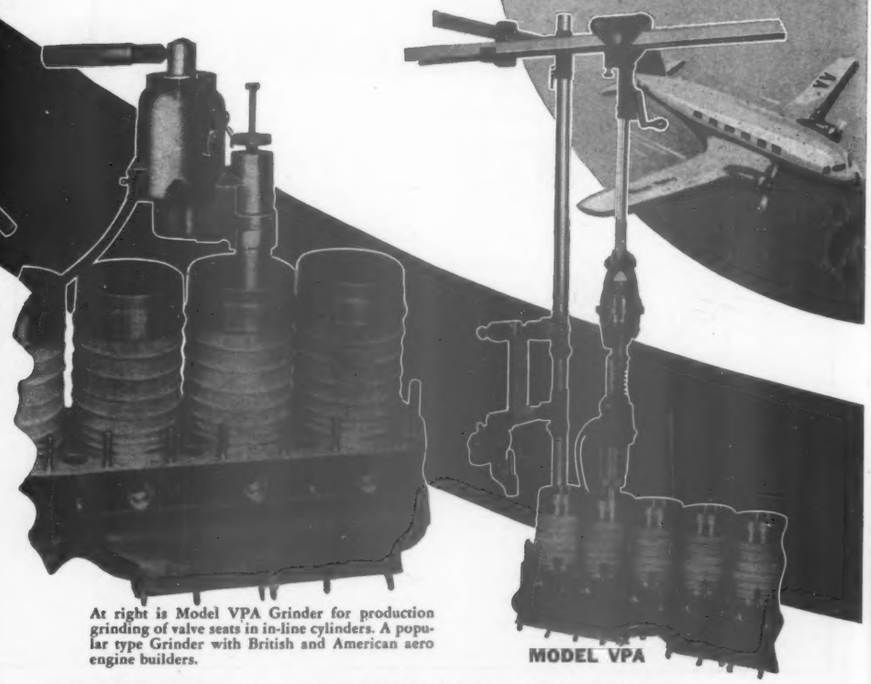
The world

The safety of a ship in flight rests upon the Pilot. In the safe grinding of valve seats the HALL patented Aero Pilot upon which the Grinder operates is an important factor in producing a valve seat true with the center of the valve guide.



HALL MODEL EJA
For Service and Limited Production

Grinds seats in straight-in-line motors. Widely adopted by leading governments. Handles seats to 3" diameter of any metal. Has grinding wheel speed of 10,000 R. P. M. and ECCENTRIC speed of 22 R. P. M. View at right shows this Grinder in use on vertical type stem guide where there are two or four valve seats in the head. Seats on an angle of 10° or thereabouts can also be handled with this Grinder. Can be supplied in various spindle lengths as required.



At right is Model VPA Grinder for production grinding of valve seats in in-line cylinders. A popular type Grinder with British and American aero engine builders.

MODEL VPA

ECCENTRIC GRINDING IS PRECISION GRINDING

All HALL Valve Seat Grinders operate on the patented ECCENTRIC grinding method. This is the only POINT CONTACT method of grinding valve seats and is responsible for the finer precision and finish and greater speed and economy obtained with HALL Grinders. But ECCENTRIC grinding offers other advantages which only serve to multiply the advantages enumerated above. Its point contact principle produces a perfect seat with the removal of a minimum of metal; by the use of the proper type grinding wheel, it grinds cast iron, bronze, hardened alloy or No. 1 Stellite with equal precision, speed and finish; it permits the grinding of 5 to 10 times more seats per wheel with less frequent need for dressing the wheel with the diamond; because the ECCENTRIC shaft, around which the grinding wheel travels at high speed, revolves on the pilot at only approximately 20 R.P.M., pilot wear is greatly minimized. The positive feed of the grinding wheel into point contact with the seat reduces the possibility of grinding wheel breakage.

THE HALL MANUFACTURING CO., TOLEDO, OHIO, U.S.A.

HALL AERO VALVE

goes to HALL

for VALVE & VALVE SEAT GRINDING EQUIPMENT

FOR PRODUCTION OR SERVICE

In any high speed, high compression, high temperature motor, performance is a matter of valve precision. That's particularly true of aeroplane motors and explains why army and navy bases of leading governments and service shops of large transport companies have adopted HALL Grinding Equipment—why over seventy manufacturers use HALL Equipment for production or recommend it for service.

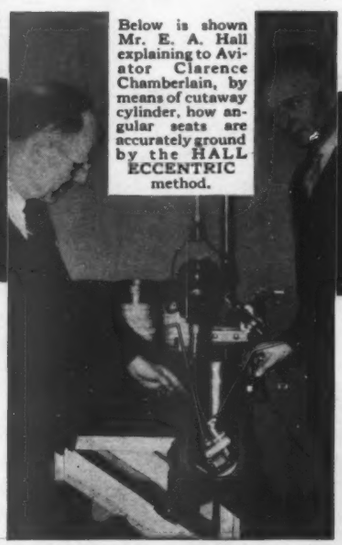
Write today for complete information on HALL Valve and Valve Seat Grinding Equipment or let HALL Engineers help solve any particular valve problem you may have.

THE HALL MANUFACTURING CO.
TOLEDO, OHIO, U. S. A.

MODEL AW—WET TYPE

Designed for safe, speedy grinding of valve seats in radial type motors. Makes blind grinding as practical as blind flying and eliminates the human element by showing on ammeter when seats are true.

The Model A. W. Grinder grinds bronze, hard steel and alloy seats to a precision and finish that permits blueing-in 100% in an average of 5 minutes per seat. Reaming or fly cutting of bronze seats is eliminated; wet grinding prevents tearing or surface burning of seat.



Below is shown Mr. E. A. Hall explaining to Aviator Clarence Chamberlain, by means of cutaway cylinder, how angular seats are accurately ground by the HALL ECCENTRIC method.

MODEL 80A WET TYPE VALVE REFACER

Has 2 speeds for large and small valves; has a special type of collet (unlike Ball Chuck) that WILL NOT BRINELL INTO VALVE STEMS; Micrometer Feed; wet grinding prevents surface burning and gives finer precision and finish.

AND VALVE SEAT GRINDERS

Synthetic Rubber Takes to the Air

By H. M. Koelliker

Synthetic Rubber Division,
Chicago Rawhide Manufacturing Co.

SYNTHETIC materials which combine the flexibility of rubber with excellent resistance to the harmful effects of oil, sunlight, oxidation and acids are so new and have so many potentialities that exploration of their field of application has only begun. Because of the newness of the art each new application is to some degree "custom-built" with the synthetic rubber compound adjusted to give the optimum desired results for that particular design.

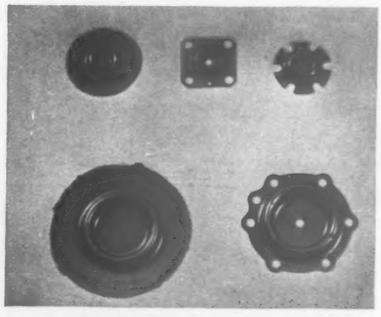
For example, a problem which recently arose was to make a diaphragm for an airplane engine carburetor. It had to be flexible, molded into a complex shape which had to be accurate in dimension, and had to withstand the harmful effects of gasoline. This particular design of carburetor had been delayed for a year because of the difficulty in finding a material to meet all the requirements. After a great deal of experimentation a compound of synthetic rubber was developed which solved the problem, but since the diaphragm had to have a uniform thickness of 0.011 in. it was also necessary to develop a molding technique which would keep out foreign matter ordinarily dissolved by the gasoline causing the diaphragm to leak.

Someone recently estimated that the tires represent only about one-third of all the rubber used in an airplane. Other uses include de-icing equipment, shock cord, hose, grommets, sealing strips, vibration dampers, engine parts, electrical parts and many others. Today many of these parts are being made of synthetic rubbers and new applications are being made because these materials combine the desirable flexibility of rubber with other qualities which heretofore were not available.

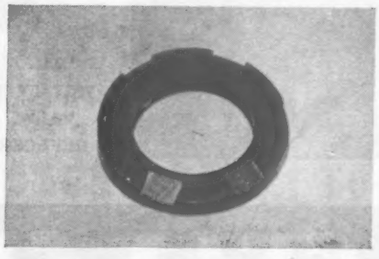
The natural resistance of these materials to oils, aging and oxidation is important in aircraft design because the airplane is almost continually exposed to weathering, extremes of temperature and climate. Also of importance are the good heat-resisting properties of some of these synthetic materials and the fact that they will not support combustion. Taken into the various qualities introduce a new and higher material factor of safety which is of course important to the designer, and synthetic rubbers are being applied primarily where leather, fabric, metal or rubber do not perform satisfactorily.

Some of the common synthetic rubber-like materials are Thiokol, Neoprene, Koroseal, Perbunan and PVA. Each has certain outstanding characteristics along with the advantages outlined above which are common to all synthetic rubbers.

Thiokol is particularly rubber-like in its characteristics. It is the most resistant of the synthetics to solvents with the exception of PVA and is practically impervious to oxidizing effects of air and ozone. Having excellent resistance to the harmful action of oil, gasoline and other chemicals it is a popular material for airplane fuel hose and can be used for oil at temperatures up to about 225 deg. F. One limitation of this material is that it is thermoplastic and will reshape itself under pressure. However, this is not serious when the tendency to flow is restrained as, for example, in a vibration damper, or when restrained by fabric as in the oil-slinger ring. Tendency of the material to cold flow is also useful in securing best sealing with fabric impregnated gaskets.



The synthetic rubber carburetor diaphragms are only 0.011 in. thick. Shown on the left after molding, they are then punched into shape as on the right.



An oil slinger ring for a rotating shaft has fabric facing to provide strength and additional wear resistance.

Koroseal is like Thiokol in that it is a thermo-plastic material. Some of its advantages are that it resists swelling due to vegetable or mineral oils; it is particularly resistant to strong corrosives such as nitric acid, sulfuric acid and hydrochloric acid; and it has possible maximum tensile strength of 7,500 lb. per sq.in. While it has good resistance to prolonged flexing, it cannot be used successfully for flexing in hot oil, being recommended for best operation at temperatures less than 150 deg. F.

Neoprene is perhaps the best known of the group because of its longer history which began under the trade name "Duprene". In addition to the properties possessed by all synthetic rubberlike materials, it has good resistance to abrasion, good damping properties and good resistance to heat. In the latter Neoprene excels other synthetics as certain of its compounds do not begin to harden until temperatures of 300 deg. F. and above are reached after which it eventually fails by embrittlement. Tensile strength varies from 200 to 4,000 lb. per sq.in. depending on compounding. Molded flexible couplings between airplane engine magneto and its drive are made of this material. Neoprene impregnated cotton fabric is used as sealing tape for floats and gas tanks. Recently neoprene impregnated cotton fabric cells have been used to line gasoline tanks. Molded neoprene and felt combinations are applicable as grease seals. Carburetor seats are being made of this material because it not only resists the action of gasoline but its rubber-like characteristics make for positive and noiseless seating.

Perbunan, originally developed in Germany and used in some forms for tires, is to be available in this country in about a year. It, too, possesses the general qualities of synthetic rubbers particularly as regards resistance to deterioration by oils. Also, it has good

(*Turn to page 125*)

Luscombe JOINS THE Lycoming FAMILY!

FOR SMOOTH, ECONOMICAL, DEPENDABLE POWER

Now Luscombe joins the parade of Lycoming power! These sleek, all-metal light planes are now available with the Lycoming 65 h.p. engine. Just as more and more Taylorcrafts, Aeroncas and Piper Cubs are flying the skyways "powered by Lycoming", so is the championship performance of this alert, responsive, dependable engine now at the finger tips of Luscombe pilots. A revelation in aircraft engine smoothness and quietness awaits you . . . behind a Lycoming, at your local airport. Fly it! Feel the difference!

FREE LITERATURE: Illustrated folders on Lycoming light-plane engines may be obtained from all Luscombe, Taylorcraft, Aeronca and Piper dealers. Or write Dept. A440, Lycoming Division, Aviation Manufacturing Corp., Williamsport, Penna., U. S. A. Cable Address: Aviatcor.

LYCOMING "65" IN THE ALL-METAL LUSCOMBE

The Lycoming 65-horsepower engine as installed in the new all-metal Luscombe. Lycoming four-cylinder, horizontally opposed, air-cooled engines are available for light planes in 50, 55, 65 or 75 horsepower, with single or dual ignition.

YOU CAN RELY ON

LYCOMING

50 to 300 H.P.

Engines

FOR MILITARY AND CIVILIAN TRAINERS ★ FOR PRIVATE AND COMMERCIAL PLANES

Flying Equipment

Dragonfly

RYAN YO-51

ONE of the most interesting, and perhaps significant, new airplane designs to be announced recently is the Ryan YO-51 "Dragonfly" short-range liaison observation plane. Developed to provide a solution to the problem of a plane that can "land and take-off anywhere" without having the relatively low-speed range associated with the autogiro type, the new "Dragonfly" has been tagged a "Flying Motorcycle" by newspaper writers.

Following closely the general design characteristics of certain of the planes developed for the famous Guggenheim Safety competition, the Ryan YO-51 is a two-place single-engine high-wing monoplane powered with a Pratt & Whitney Wasp of 420 hp. Propeller is a two-blade Hamilton Standard with diameter of 8 ft. 9 in. The approximate gross weight with normal load is 3,900 lb., wing span is 52 ft., length 34 ft. 5½ in., height 11 ft. 1 in., and wing chord approximately 92½ in. Performance figures are still on the military restrictions list, and no other specifications have been issued other than those given above.

However, an educated approximation shows that the total wing area with flaps retracted is about 400 sq.ft., which gives the plane a wing loading

A striking feature of the plane is its wide tread landing gear with long stroke shock absorbing struts to cushion the effects of near vertical landings.

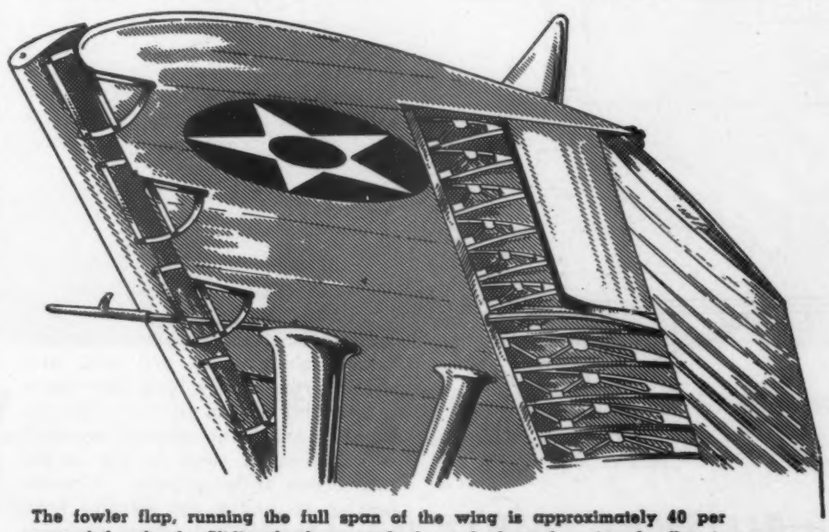
The YO-51 was tagged the "Flying Motorcycle" because it is expected to replace the motorcycle for transporting officers.

of 9.75 lb. per hp. and a power loading of about 9.3 lb. per hp. Thus with such relatively low wing and power loadings the plane would have a wide speed range, when used with or without slots and flaps. Estimates on this are from about 45 m.p.h. landing speed (slots and flaps closed) to 150 m.p.h. top speed. Obviously, with slots and flaps functioning, the landing speed drops enormously, in the range of as low as 25 m.p.h. in still air, which means that the plane can virtually hover in mid-air or descend vertically if there is a slight breeze blowing, and can take-off with almost zero run. Observations have shown this to be true. This means that the plane can move about with normal high speed, but can drop into and climb out of extremely rugged terrain. Thus military advantages, both for observation and liaison work are numerous, and it should be expected also that such planes will find a place in the private and commercial field in the near future.

Effectiveness of the Ryan slot and flap system is greatly increased by the fact that it extends for the full length of the wing, which is mounted well above the fuselage on cabane struts. Flaps are of the Fowler type, and are approximately 40 per cent of the total normal wing area, amounting to a retractable wing which, when extended, is slotted and set at a high angle of incidence. No information on the aileron system has been released, but indications are that it involves an upper-surface form of lateral control, only.

Construction of the "Dragonfly" follows conventional pratice, with semi-moncoque sheet aluminum fuselage structure, the forward portion of which is of welded steel tube framework; wood wing structure with two spars and two struts, the wing being straight across, and constructed in two panels which are pin jointed to the cabane struts. The entire upper surface of the wing is covered with plywood, and the lower surface also to a point 8½ in. back of the center line of the rear spar. Control surfaces are of aluminum alloy framework with fabric covering. A striking feature of the plane is its wide tread landing gear with long stroke shock absorbing struts to cushion the effects of near-vertical landings.

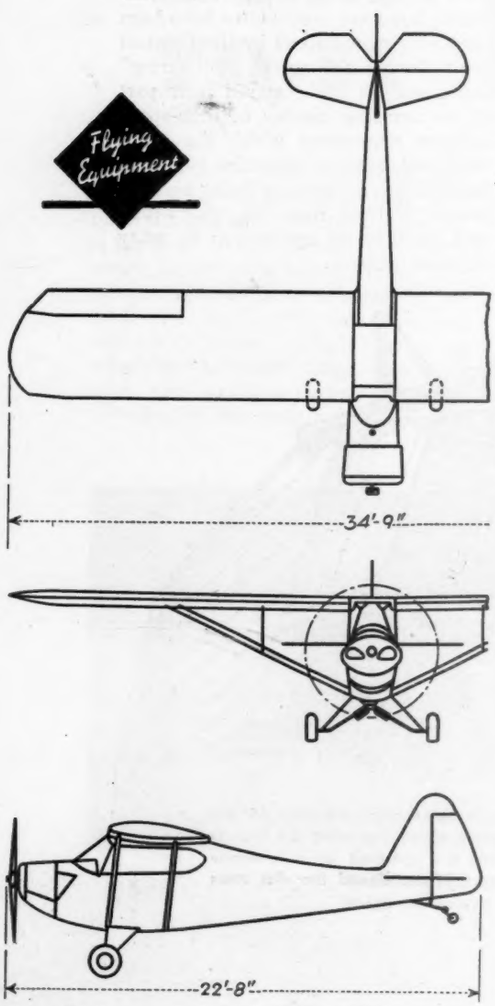
Reason for name "Flying Motorcycle" is that it is intended to displace the motorcycle as a means of transporting Army staff officers from place to place in zones of military action, especially during a campaign which might find important troop movements in progress in areas not served by highways, or where the highways were choked with transport vehicles. Such planes are reported to have been used widely in Poland by the German army during the recent "Blitzkreig" there, and no doubt played their part in the amazing display of high-speed military maneuvers which the world witnessed. Such a plane also has great possibilities for private flying and the lessons learned from its observation may have broad application to many airplane designs.



The fowler flap, running the full span of the wing is approximately 40 per cent of the chord. Sliding back on tracks located along the wing the flap is shown in the open extended position. The slots are operated by a leverage system located as shown underneath the wing. When closed the slot rests smoothly on top of the leading edge.

PORTERFIELD Trainer For 1940

By F. B. Johnson
Chief Engineer, Porterfield Aircraft Corporation



WITH so much attention being focused on safety features being built into light planes it is worth noting when a ship can recover in less than a turn from a six spin turn, when controls are released. Such is one of the performance characteristics of the new Porterfield Trainer, Model CP-65. The new ship although a development of the predecessor, Model CP-50, has been completely re-engineered and the following description explains some of the engineering changes.

The wing has been increased in strength by 30 per cent having spars of solid spruce with spruce and plywood reinforcements. Ribs are of the rigid truss type with plywood gussets nailed and glued in place. The ailerons are slotted using box spar construction with spruce and plywood. Two and one half pounds of lead in the outer leading edges provides a high degree of dynamic balance.

The horizontal surfaces have been re-designed and are of chrome molybdenum tubing spars, and mild steel channel ribs. They have been static tested with a load of over 850 lbs. Fuselage and fin are covered together, which forms a clean fairing at the intersection of the surfaces. A needle bearing is used at the elevator horn to take the cable loads with a minimum of wear and friction.

The fuselage, of conventional welded steel tubing, has been built for easy maintenance. All longerons and members around the cabin are of chrome molybdenum steel tubing, and the door has been re-designed to prevent drafts. The model 65 is finished with eight coats of dope. The De-Luxe models have hand rubbed fuselage and tail surfaces. Conventional inspection hand holes and grommets obviate the necessity of cutting the fabric for periodic inspections. The Control System is completely dual even to the dual brake pedals and dual fuel shut-off controls. The landing gear utilizes six rubber discs, in compression, as a shock absorbing element. Six inches vertical deflection is provided, and much of the energy absorbed is by friction, which together with a landing angle of 10 degrees prevents any tendency to bounce or porpoise. A six inch tail wheel, either full swivel or steerable, has been used.

The 1940 Porterfield is available with any of the Continental or Lycoming engines of 50, 55 or 65 h.p.

The following performance is obtained with a full load, without pants or special streamlining.

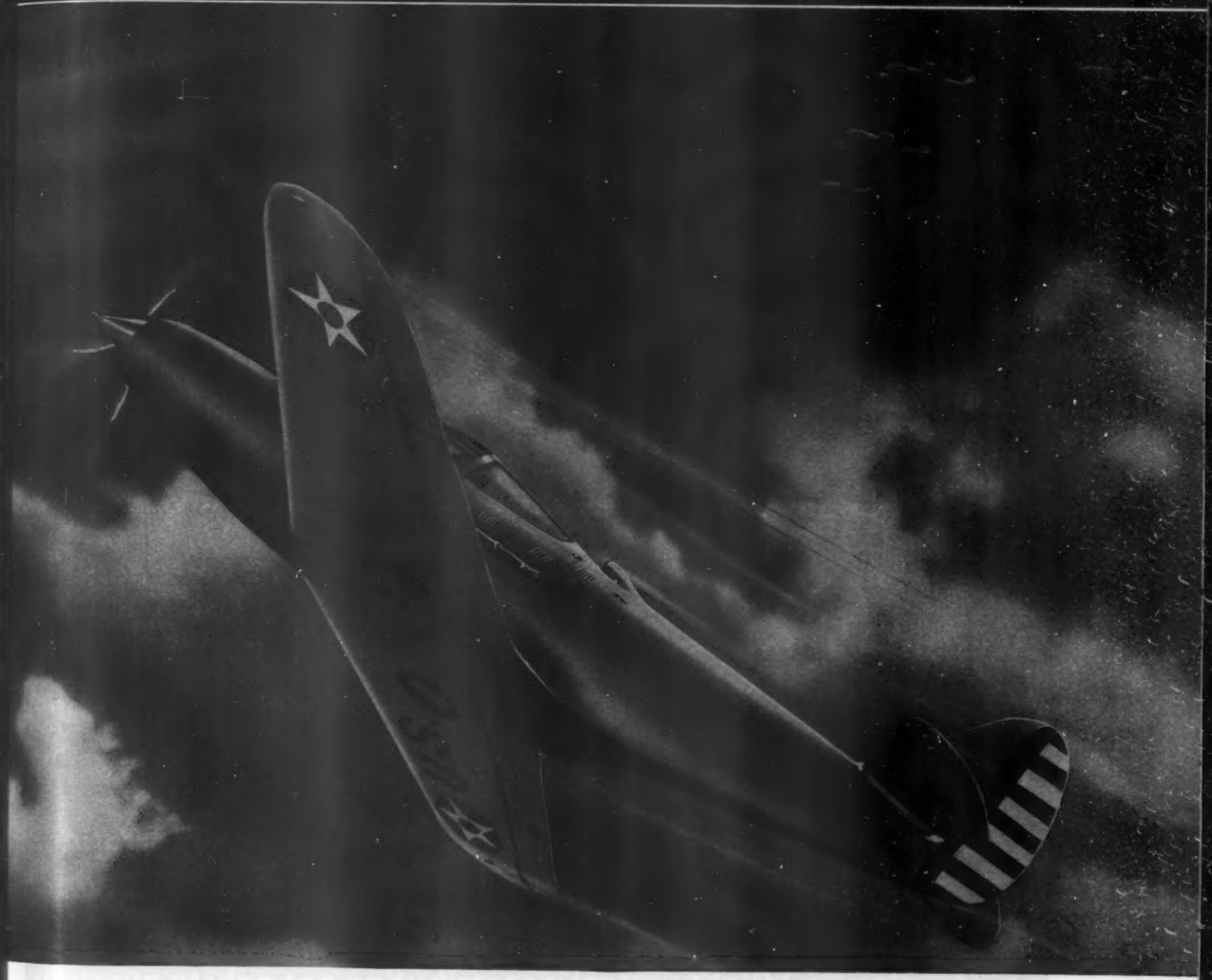
Performance, Model CP-65

High Speed	108 mph
Cruising Speed—80% of Rated Power	97 mph
Cruising Speed at 6000 ft.—80% of Rated Power	103 mph
Rate of Climb—Sea Level	700 ft. per min.
Take-off and Clear 50 ft. Obstacle (Still Air)	320 yds.
Stalling Speed	37 mph
Range	320 miles

Specifications

Length	22 ft. 8 in.
Span	34 ft. 9 in.
Wing Area	169 sq.ft.
Weight Empty, Standard Equipment	660 lb.
Useful Load	500 lb.
Gross Weight	1160 lb.
Baggage Capacity	40 lb.

The "COBRA" Bares its Fangs...



BELL *AIRACOBRAS* NOW IN PRODUCTION FOR THE UNITED STATES ARMY AIR CORPS

Superior

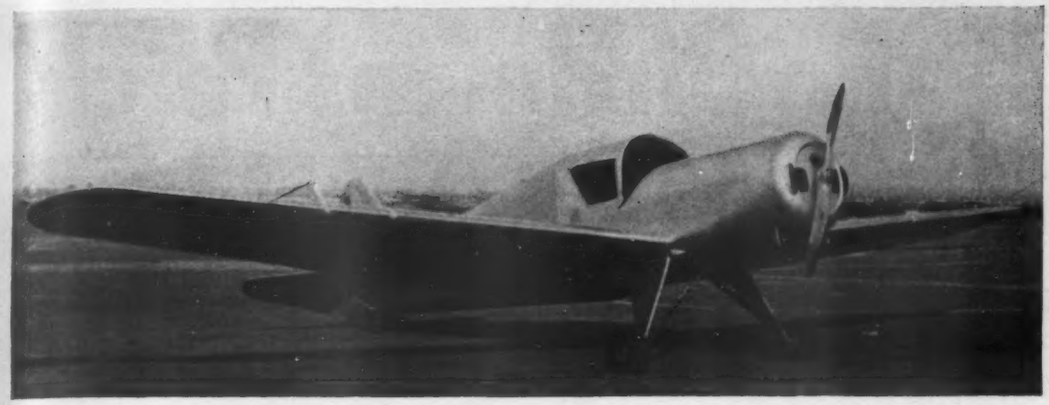
SPEED!
FIRE POWER!
VISION!
MANEUVERABILITY!

BELL
AIRCRAFT CORPORATION
BUFFALO, N. Y., U. S. A.
"WINGS FOR THE TODD..."

Here comes your morning mail...

Whether or not you fly as a passenger, you, too, have an important stake in aviation. Overseas mail reaches your desk in days instead of weeks. Your check from the coast clears overnight. Your morning paper carries pictures taken the day before in a city 3,000 miles away. In a hundred different ways your life is affected by this miracle of modern transportation. And Sperry's continuous development of finer instruments for navigation and flight control is contributing not only to aviation —but to the comfort, convenience and security of your daily life.

SPERRY GYROSCOPE COMPANY, Inc.
BROOKLYN, N.Y.



Flying Equipment

Johansen JA-2

WITH numerous new features to merit the consideration of prospective lightplane purchasers, the Johansen JA-2 two-place, side-by-side, low wing monoplane has made its bow on the West Coast at Los Angeles, Calif. Flight tests have been made with the 40 h.p. Continental engine and have served to demonstrate the favorable flying characteristics and performance of the plane, but the production model will be offered with a 50 h.p. engine.

Designed to compete in the lowest price range of the lightplane field, the Johansen incorporates a number of big plane features, such as the full cantilever wing with monospar structure. Low manufacturing cost has been achieved through use of a simplified wood structure throughout. The fuselage is a simple cone, of oval cross section back of the cabin, with four spruce stringers, and spruce bulkheads, covered with three ply mahogany "plastic" bounded plywood. The monospar wing is plywood covered forward of the spar and cloth covered in rear of the spar. The engine is mounted direct to the wood fuselage structure at the upper mount holes, and by means of a simple steel tube strut arrangement to the lower support points, permitting very quick removal or attachment of the engine. This mount also serves to act as a vibration absorbing medium. Full accessibility for inspection and maintenance is provided by an automobile type cowl around the lower portion of the engine compartment.

Landing gear is of conventional tripod strut type, fixed, with shock cord shock absorbing units. A steerable tail wheel is provided at the rear. Entrance to the cabin is by means of a large folding door at the left side which raises upward. Ample room is provided for two large people. Vision is excellent, and the noise level has been materially reduced by the wood construction. Specifications of the plane, and performance figures based on flight tests, are given by the manufacturer as follows:

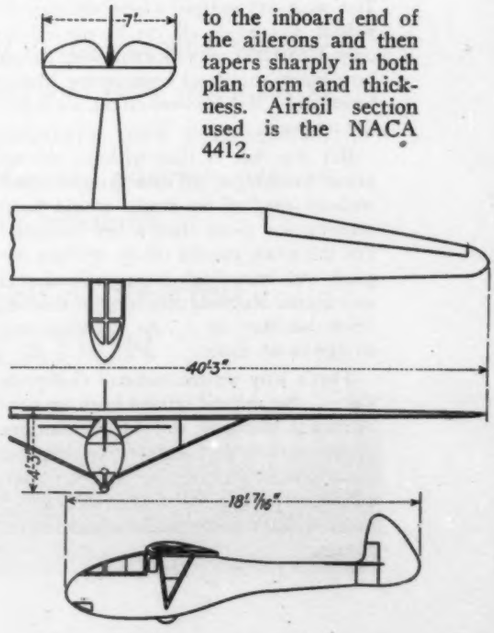
Model.....Johansen JA-2
Type....Cantilever low-wing monoplane
Capacity....Pilot and passenger (dual controls)
Dimensions:
Span.....35 ft. 8 in.
Length.....21 ft. 7 in.
Height.....6 ft. 9 in.
Wing Area.....165 sq.ft.

Weights:
Empty.....612 lb.
Fuel .....60 lb.
Oil.....8 lb.
Baggage.....40 lb.
Gross wt.....1060 lb.
Wing loading.....6.56 lb./sq.ft.
Power loading.....26.20 lb./hp.
Performance: with power plant—
Continental A-40-4.....40 h.p.
High speed.....85 mph
Cruising speed.....75 mph
Landing speed.....35 mph
Climb (initial).....450 ft./min.
Service ceiling.....12,500 ft.
Cruising range.....250 miles

Instruments:
Tachometer, oil pressure gauge, oil temperature gauge, altimeter, air speed indicator, fuel gauge.
Tires—Goodyear Airwheels 18 x 8 x 3.
Propeller—Sensenich Brothers.

Briegleb Glider

ROUNDING out its line of sailplaning equipment the Briegleb Aircraft Company, Van Nuys, Calif., builders of the popular Briegleb utility sailplane, has recently added a high performance sailplane for the advanced soaring pilot. Following closely the design of the original Briegleb utility, the new sailplane is of conventional construction, with steel tube fuselage structure, cloth covered, and wood wing, strut braced and cloth covered. The high performance sailplane has a two-spar wing with double strut bracing. Span is 40 ft. 3 in., wing area 123 sq.ft., empty weight 230 lbs., weight loaded 420 lbs., and wing loading 3.4 lbs./sq.ft. German type spoilers are incorporated in the wing to cut down landing float. Stalling speed is approximately 30 mph. The wing is straight across to the inboard end of the ailerons and then tapers sharply in both plan form and thickness. Airfoil section used is the NACA 4412.



The Birdmen's Perch

Below are listed the balance of the solvers of the December problem. That is, all who sent in their solutions before the deadline we had to set in self-defense. In order to bar having to print a special Honor Roll next November for that one very welcome letter that always comes in eight months after publication from a fan in Johore, Pago Pago, or Tanganyika.

"Tattered Wing-Tips," Editor, The Birdmen's Perch, Room 3800, Gulf Bldg., Pittsburgh, Pa.

REPEAT PERFORMANCE

On February 15th the National Safety Council handed out its Certificates of Special Commendation for 1939.

Right up there, leading the parade in safety achievements, were three old friends of ours who will be hanging up this year's certificates next to the ones they won last year and in years previous.

The friends:

American Airlines, Inc.
Eastern Air Lines, Inc.
Pennsylvania-Central Airlines Corp.

All three are good Gulf customers. Eastern Air and Penn-Central use only Gulf Aviation Gas and Gulfpride's commercial twin, Gulf Airline Oil. American buys G.A.G. in certain territories.

We're proud to do business with such consistent topnotchers.

WHAT PRICE FRICTION?

The other day we read where 500 tons of weight, floated on oil, can be moved by only 1/650,000 of a horsepower. As to how many thousand horsepower would be required, if there were no oil, we shudder to guess.

But the fact is that without oil no plane would get off the ground. And without *good oil* no motor would keep running for more than a few minutes. For the strain put on oil by modern engines with their high-compression ratios and higher temperatures is such that inferior oils burn up . . . go to carbon and sludge in no time.

That's why we recommend Gulfpride Oil . . . the *only* oil refined both by conventional methods and by the famous Gulf-invented Alchlor process. It's this extra, unique process that digs out up to 20% more carbon and sludge formers . . . makes Gulfpride the world's finest oil for planes.

★ HONOR ROLL ★

Matthew Verknyl; Sam Yankelowitz; Fred G. Taintor; Hugh V. Williams; Eugene Edminster; Jimmy Creaser; Alfred Portinga; Howard J. Strauck; Bill Keienburg, Jr.; Fred Knowles; Fred Kelly, Jr.; Bob Stotts; Fred McMaster; P. D. Andrews; Sidney Bobo; Harry E. Chambers; Bob Newill; John F. Suydam. Congrats to all!

OLD-ENOUGH-TO-KNOW-BETTER DEPT.

The combined ages of a pilot and his plane are 35 years.

When the pilot was twice as old as the plane is now, he was twice as old as the plane was then.

How old is the pilot and how old is the plane?

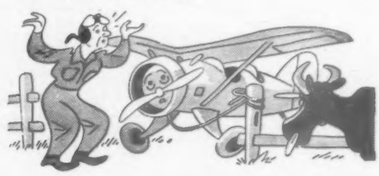
(Mail in your answer today to T.W.T. We'll shoot back the official by return mail.)

THIS MONTH'S WHOPPER!

Dear T.W.T.:

Here is my contribution to This Month's Whopper. If it's true, then I'm a liar.

After barnstorming all last Summer, I checked my profits—or else—and decided to tie her to a fence to slowly rot away. Make more money that way.



Naturally when anyone retires they raise chickens or Hell. I took chickens (having done my Hell raisin' previously) and, to soothe my nasty disposition, a rattlesnake by name of Buzzie for a pet.

Now Buzzie was in the habit of slipping into the hen house to get himself an egg. Inside, one day, he ran onto an old doorknob. "Nice egg," says Buzzie. "Nice eating." So down it went.

When about halfway out through his favorite knothole in the door, he spied the other doorknob which had fallen off on that side. "Well, guess I can stand one more," says Buzzie.

Now then we got something to think about. Buzzie with a knothole around his middle and him around a doorknob on each side the knothole. "Buzzie," says I, "this is going to take headwork. Digest 'em—long time. Break 'em—nope. Hurt Buzzie."

Two days Buzzie was in despair (also in the knothole); then it struck.

"Buzzie," says I, "your venom ain't got oomph." So I tore for the house, got a medicine dropper, filled it with a few drops of Gulf Aviation Gas out of my tank and shot it down Buzzie's throat.

Whang! Out the door he came—knothole and all. He coiled three times and took off East.

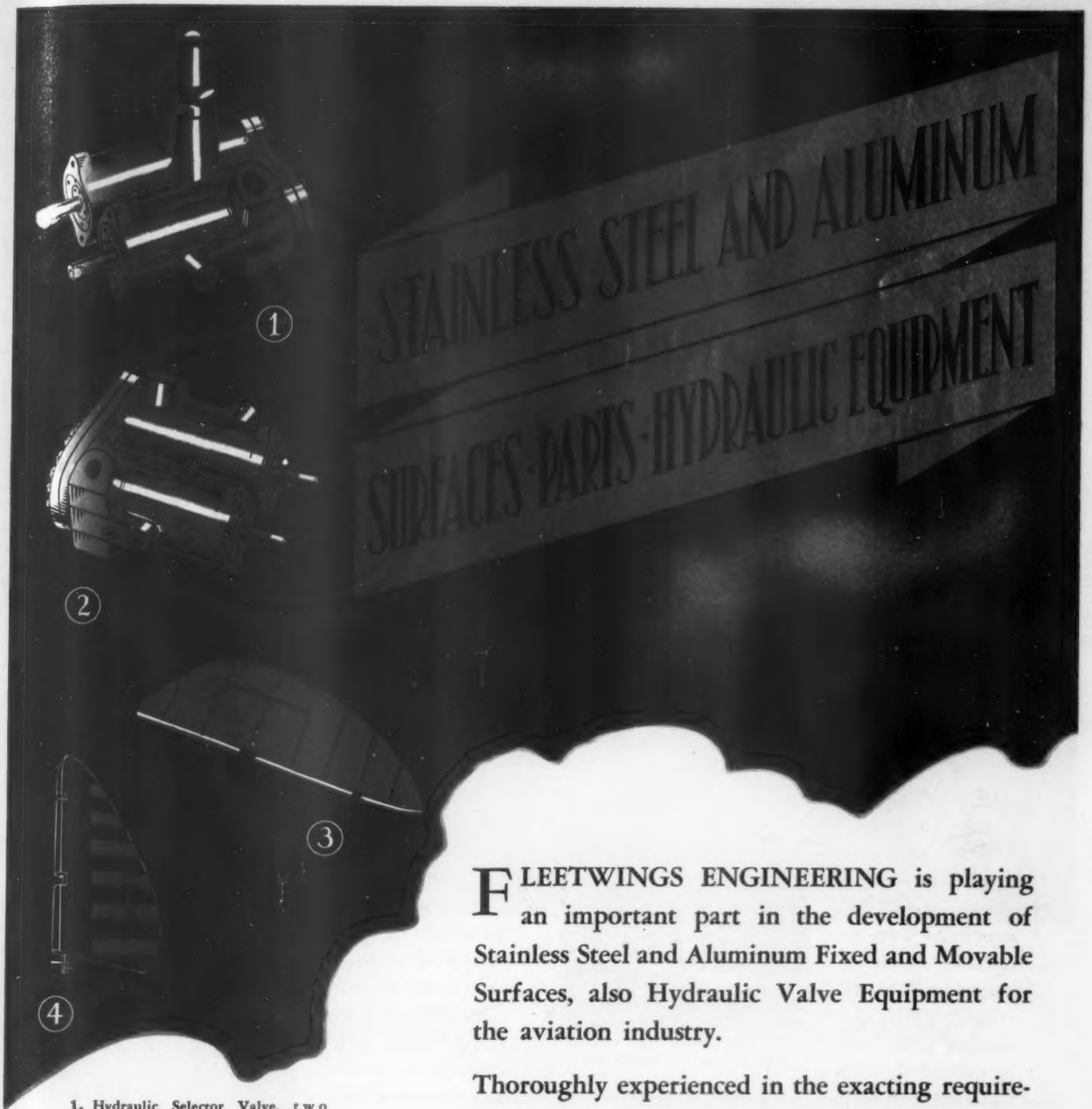
Noise! You shoulda heard his rattles. Their roar run half of Europe into their bomb shelters when he passed over.

O. A. Moritz

P. S.—Buzzie came gliding in just now. Says, "Make mine sparrow eggs. And Gulf Aviation Gas! Takin' no more chances."

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF **GULF AVIATION PRODUCTS**



1. Hydraulic Selector Valve, two unit, including safety valve for hydraulically retracting landing gears.
2. Hydraulic Selector Valve, two unit, for hydraulically operated landing gears.
3. Stainless Steel Elevator.
4. Stainless Steel Rudder.

Specializing in the production of Wings — Fixed and Movable Surfaces — Tanks — Fire Walls — Bomb Bay Doors — Bomb Chutes — Bomb Racks — Ammunition Boxes — Junction Boxes — Hydraulic Equipment — etc.

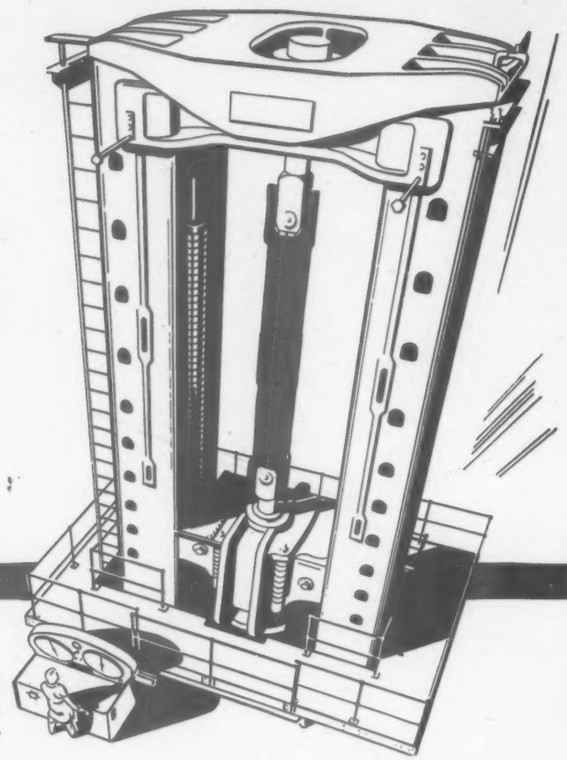
FLEETWINGS ENGINEERING is playing an important part in the development of Stainless Steel and Aluminum Fixed and Movable Surfaces, also Hydraulic Valve Equipment for the aviation industry.

Thoroughly experienced in the exacting requirements of aircraft building and fully equipped to meet the demands of military and commercial manufacturers, thus definitely assuring prompt and dependable delivery schedules.

DESIGN • ENGINEERING FABRICATION

FLEETWINGS
INCORPORATED

HERE IS A *New Frontier* OF AVIATION PROGRESS

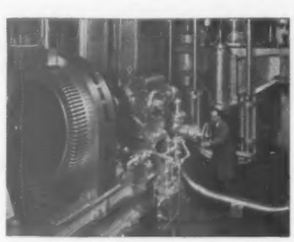


The Templin Testing Machine, just installed at Aluminum Research Laboratories

This new testing equipment installed in Aluminum Research Laboratories is the most powerful device of its kind in the world. It can exert a force of 3,000,000 pounds in compression and of 1,000,000 pounds in tension, at speeds up to 38 inches per minute. Yet it is sensitive enough to measure a load of 25 pounds, and accurate to within one-half of one per cent. The machine can be operated as an experimental extrusion, forging, or forming press, and is provided with auxiliary equipment which permits defining, within close limits, the relationships existing between the various forces involved in the plastic flow of Aluminum throughout a wide range of temperatures.

Making extensometer readings during a tension test

Those words "extrusion, forging, or forming," together with the ability of this equipment to test large structural members or assemblies, such as wing and fuselage sections, landing gear, etc., suggest exciting implications for aircraft construction. To many of the questions which designers and production men are asking there can now be precise answers. For with this machine, it's possible to cross a new frontier in research, to get data hitherto unavailable.



Driving equipment and lower portion of the Templin Machine

Which illustrates, simply and concretely, how the continuing program of making Alcoa Aluminum Alloys more useful dovetails into the requirements of the aircraft industry. ALUMINUM COMPANY OF AMERICA, 2182 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

*Sit in luxury's lap..AND GO LIKE A BULLET**

New WACO MODEL "E" AIRISTOCRAT is fastest — most comfortable airplane of its power class ever built

ALL the comforts of a fine automobile—deep, spring-type cushions—not makeshift luggage covers—every conceivable luxury—that's the Airistocrat—the new Waco Model "E."

Speed like a permanent "tail wind"—cruising as high as 200 miles per hour. "Cushioned power" engine mounting. You slide through the air faster—and with the lowest cost per horsepower mile.

See the new Waco "E" Airistocrat before you consider anything else. We'll gladly send the name of your dealer.

**Of course, it's not actually as fast as a bullet—but it's the next thing to it.*

ABOVE—WACO MODEL "S"
BELOW—WACO MODEL "N"

WACO AIRISTOCRAT

Now available with Lycoming engine in addition to Jacobs, Pratt Whitney, Wright

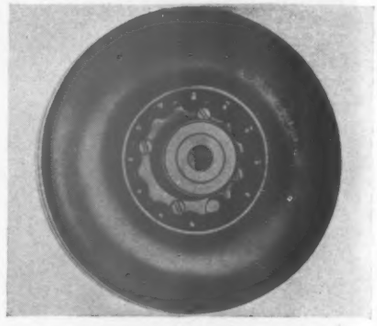
WACO AIRPLANES

THE WACO AIRCRAFT COMPANY, TROY, OHIO

BUYER'S LOG BOOK

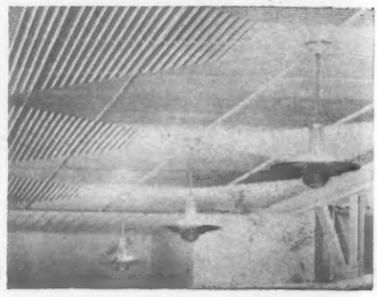
What's New in Accessories, Materials, Supplies, and Equipment

Resembling a lug base pneumatic tire in appearance, a new small cushion wheel with non-skid tread is offered by The Geneva Metal Wheel Company, Geneva, Ohio. The rubber stock is similar to solid rubber but is more resilient. Eliminating punctures and inflation service, this little wheel is offered for lightplane tailwheel service. Tire size is 6 x 2.00 in.—AVIATION, *April, 1940.*



Geneva cushioned wheel

Throwing new light on new problems might well be the sales theme of the Berger Manufacturing Division of the Republic Steel Corp., Canton, Ohio, in selling their Parabolume ceiling lighting unit to aircraft office executives, drafting room personnel, etc. The new unit is a simple development of the parabolic reflector, which lies flat against the ceiling of office, drafting room, or shop, and directs light evenly over a wide area from a central light source by means of reflector vanes arranged in a suitable frame and attached to the ceiling in such a way as to cover all, or a large part of the ceiling area. The effect is to make of the entire ceiling an efficient light reflecting and directing medium, in conjunction with suitable indirect light sources of rather conventional types.—AVIATION, *April, 1940.*



Berloy Parabolume ceiling unit.

Combining the qualities of a universal cutter grinder and a precision surface grinder in a single machine, the new DoAll Grinder developed by Continental Machines, Inc., Minneapolis, Minn, should find wide application in aircraft machine work, where versatility of tooling is so important.—AVIATION, *April, 1940.*

Numerous refinements are incorporated in the 1940 line of Ace spot welders offered by the Pier Equipment Manufacturing Company, Benton Harbor, Michigan. Rather than trying to describe all these features we are suggesting instead that you write them direct for their complete catalog on this equipment, as it gives details which could not be adequately covered here.—AVIATION, *April, 1940.*

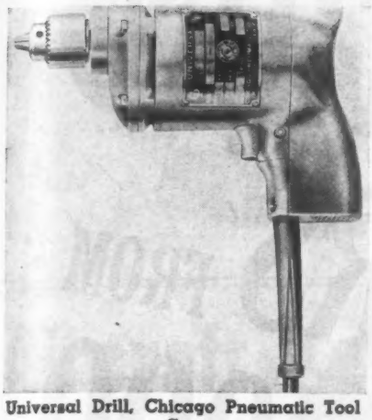
DoAll Grinder

Designed to withstand the shock of being run over by the largest aircraft, a new runway marker light offered by Pyle-National Company, Chicago, Ill., meets the latest CAA specifications in both materials and performance. The light fixture is completely enclosed and sealed against dirt and moisture. The exterior is so designed that no dirt can accumulate over the glassware, yet the height is only two inches above ground level. The body of the fixture is provided with large wiring space for ease of installation.—AVIATION, *April, 1940.*

Specially designed for aircraft and other light production work, the new Oxweld oxy-acetylene welding blowpipe—Type W-29—has a wide field of usefulness in welding metals up to $\frac{3}{8}$ in. thick. Its light weight (15 oz.), small size, and slender lines make it particularly suitable for welding in inaccessible places. It is ruggedly constructed, however, and features increased flashback resistance, greater valve capacity than usual for blowpipes of this size, small size screw type hose connections on the blowpipe handle, and eight different welding tips. Further information may be obtained from the manufacturer, The Linde Air Products Company, 30 E. 42nd St., New York, N. Y.—AVIATION, *April, 1940.*

A special aviation enamel developed by the Glidden Company, of Toledo, Ohio, is offered under the trade name One-Coat Airplane Finish, and offers the double advantages of light weight and fast handling. One-Coat Finish is out of dust in 20 minutes and may be handled in two hours. It is claimed to be more durable and adhesive than lacquer, yet produces a desirable high-luster finish, is tough and elastic and shows high resistance to vibration and skin friction. Spray applied solidly in one coat over bare, unprimed dural or aluminum, this finish is impervious to gasoline and lubricating oils and, after a period of use-hardening, is unaffected by corrosive anti-freeze compounds. —AVIATION, *April, 1940.*

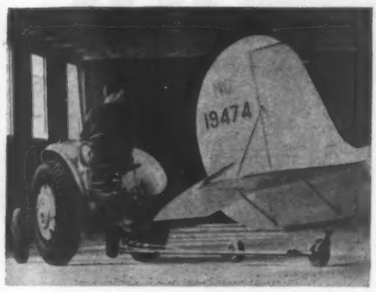
Pyle-National Co., runway light



Universal Drill, Chicago Pneumatic Tool Co.

A light-weight Rivet Squeezer has been introduced by the Independent Pneumatic Tool Co. for aircraft rivet squeezing of $\frac{5}{32}$ in. dural and aluminum rivets. It is just 12 in. long and weighs $7\frac{1}{2}$ lbs. Designated the Thor PRS-1 rivet squeezer, the new tool is intended for quick changing of yokes, plungers, and cuppings, without dismantling the tool. In the Thor squeezer the plunger can be installed and removed without using any tools by simply pushing the plunger holder backwards with the fingers to automatically release the plunger. A pressure regulator permits the operator to drive both short and long rivets without changing the yoke or plunger. A stroke regulator quickly adjustable for different strokes facilitates speed in riveting.—AVIATION, *April, 1940.*

Streamlined to aid working in restricted positions, and to protect the machine from damage in the event of bumps, the new CP universal electric drill offered by the Chicago Pneumatic Tool Company, New York, is designed for metal or wood drilling up to $\frac{1}{4}$ in. capacity. The drill has been designed for unusual resistance to wear and abuse. It may also be used as a screw driver or nut runner.—AVIATION, *April, 1940.*



Allis-Chalmers Model "IB" tractor

Of interest to airlines, airports, and anyone requiring a compact industrial tractor, is the new Model "IB" machine announced by Allis-Chalmers Manufacturing Company, Milwaukee, Wisc. With 13.5 drawbar h.p., and weighing 2140 lbs., this versatile mechanical mule sets low to the ground and has the stability and power to do an all-around job under extreme conditions of terrain and weather.—AVIATION, *April, 1940*

A whole new technique of thread machining has developed as a result of aircraft requirements for better, stronger, threads on engine cylinder studs. Out of this problem developed the ground thread and as a result ground threads have become widely adopted as they appear to have the finest thread finish obtainable. Special grinding wheels developed by the Carborundum Company have made it possible to grind internal as well as external threads on a wide range of applications to aircraft and other work.—AVIATION, *April, 1940.*

Samples of ground threads

More working strokes per hour are achieved in the latest models of Niagara Power Squaring Shears through more convenient arrangement of controls and gages, full visibility of cutting line, instant acting 14-point engagement sleeve clutch, complete accessibility of the shear at the rear (poetry), as well as increased operating speed of the shear itself. Produced by the Niagara Machine & Tool Works, Buffalo, N. Y., this line of shears has numerous other features which will recommend them to aircraft people.—AVIATION, *April, 1940.*

Application of die casting to aviation production problems has brought rapid development of pressure die casting machinery. Latest such machine to be announced is a self contained fully hydraulic pressure die casting machine, Model 200, for die casting of aluminum, zinc, and brass alloys, offered by the Dycast Products Division of Monarch Aluminum Mfg. Company, Cleveland, Ohio. The Monarch die casting machine provides a die opening of 12 in. and a die space of 12 in. to 32 in. It will operate at the rate of 600 shots per hour at a pressure per square inch ranging up to 16,000 lb., with a locking pressure of 250 tons. Floor space occupied is 60 by 186 inches and weight is 18,000 lb. Capacity of the melting pot is 250 lb. of aluminum, or 750 lb. of zinc or brass. A great many features have been incorporated in this machine as the result of years of die casting experience by the manufacturer. AVIATION, *April, 1940.*

Niagara Power Squaring Shears in sizes from 10 gage to ½ in. inclusive.

DIRECTION FINDERS FROM $39.50 TO $4,000 BY LEARADIO

LEADS THE WORLD IN THE MANUFACTURE OF AERONAUTICAL DIRECTION FINDERS

A Learadio Direction Finder to meet every requirement

APR-1 Portable AC-DC-battery receiver with built-in loop

MDF-2 Portable AC-DC-battery receiver with rotatable loop and marine azimuth scale

AMRL-1 Popular-priced aircraft receiver with rotatable loop and azimuth scale

ADF-1 Beacon band automatic direction finder and receiver

ADF-6 Automatic direction finder on all frequencies between 180 and 2800 Kc—a receiver on all frequencies between 180 and 6700 Kc

ADF-7 Same as ADF-6 but featuring quadrantal error corrector, manual loop crank and CAATC #344

ADF-8 Scheduled air transport type with remote tuning, quadrantal error correction, and manual loop crank

LEAR-MATIC Combines the functions of the ADF and a gyro-compass, resulting in an automatic drift compensator, and instrument approach system. Every transmitter becomes a radio range. Assuredly the ultimate instrument for aircraft navigation!

SEND FOR DETAILED INFORMATION ON ANY MODELS WHICH INTEREST YOU

★ **LEAR AVIA, Inc.** *Roosevelt Field, Mineola, Long Island, New York · Factory: Dayton, Ohio*

THE AVIATION NEWS

REVIEW, COMMENT, FORECAST

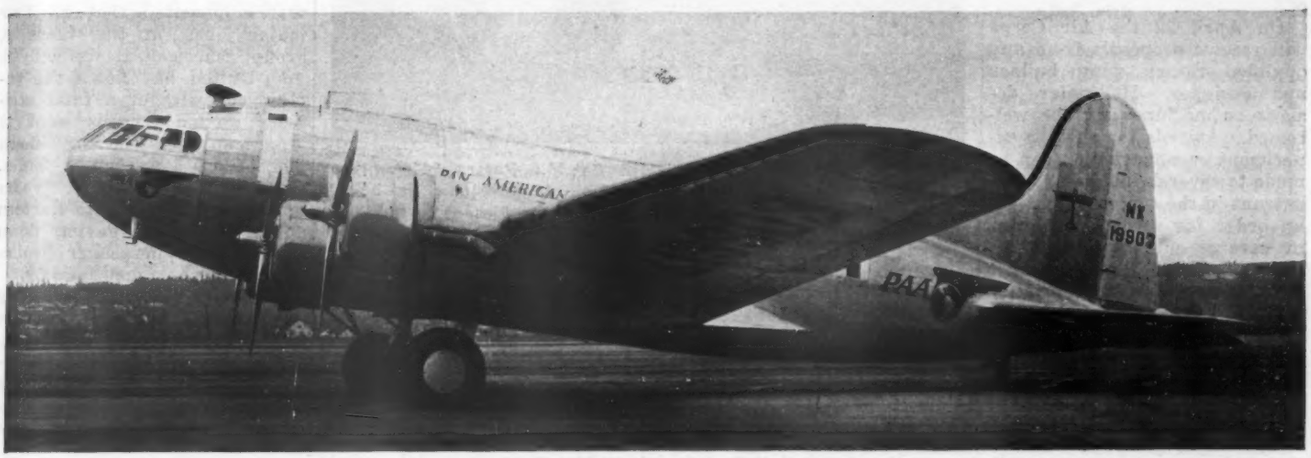
BLAINE STUBBLEFIELD
Washington

C. F. McReynolds, Pacific Coast
Jay P. AuWerter, New York
E. R. Lockin New York

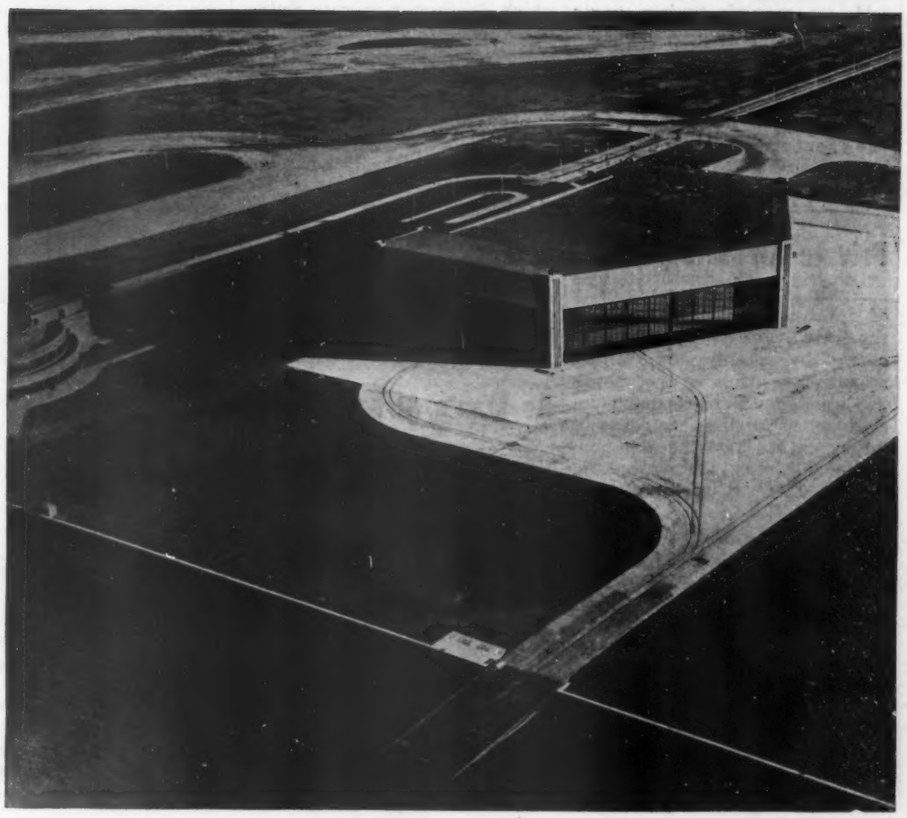
APRIL 1940

Aircraft Keynotes U. S. Foreign Policy

(Story on page 87)



NEW WORLD PORT AND PLANE are ready to build industry and commerce in the Western Hemisphere while too much of aviation in the less fortunate old world is tearing things down. ABOVE is the latest ship of the air, the Boeing Strato-Clipper "Flying Cloud," recently delivered to Pan American for operation between the United States and South America. It has a wing span of 107 feet; gross weight 45,000 pounds; carries 33 day passengers and sleeps 25 —plus a ton of mail and express. Cabin is sealed and stressed to hold an internal air pressure of six pounds to the square inch, more than twice the super-charge necessary for breathing comfort without oxygen at 20,000 to 25,000 feet. A second ship is being delivered about April 1, and a third will come later.



RIGHT is the new flying boat hangar which Pan American has leased at La Guardia Field, New York, for its Trans-Atlantic and Bermuda service; it will be occupied about March 31. Notice the little railroad on which beaching gear travels. At left is part of administration building of the marine terminal, which is used as a customs station for all foreign service planes, sea and land. It is expected the British will re-instate Trans-Atlantic service, using this terminal, some time in June.

NATIONAL AVIATION

Giro Designers Compete

WASHINGTON (AVIATION BUREAU)—Probably no aircraft ever created as much interest, and proved out as well, and was less in demand than the autogiro. But just as the Navy is now in the process of rescuing lighter-than-air, which came near oblivion though it showed great merit, so the Air Corps is sponsoring a government move to make sure that the rotary wing principle is made full use of.

On April 22 the Air Corps will receive proposals from any qualified rotary wing builder and designer. Helicopter designs or machines will be welcomed. Awards for further experiment or construction can be made to several "bidders." One entrant in the contest might get an order for several machines, or several entrants might get orders for one. This contest is a followup on an appropriation by Congress under which several government departments are authorized to use rotary wing craft experimentally to determine new uses.

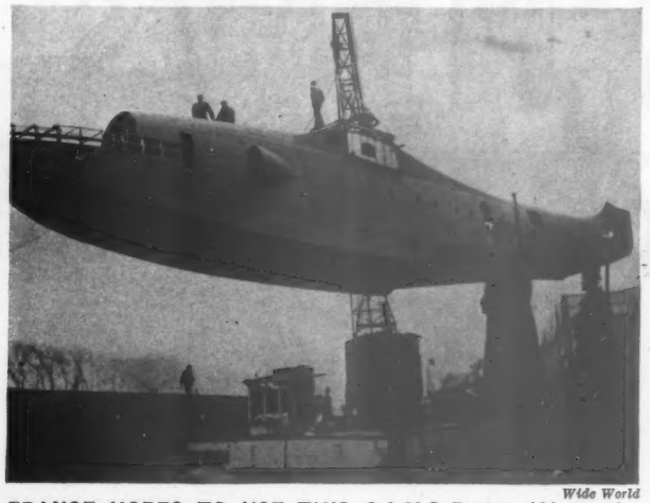
Meanwhile, Kellett Autogiro Corporation, which showed losses in 1938–39, is supporting itself by manufacturing parts for other airplane manufacturers. Company's current unfilled orders total $405,000, the biggest in its history. Thus the possessors of valuable rotary wing experience are standing by for service as soon as their product can be marketed.

Private Air Safety

Again in February a majority of fatal accidents analyzed by the Air Safety Board were caused by spinning or stalling and diving. During the month 205 accidents were reported, including two airline accidents of minor nature. Of the 203 non-airline mishaps, 23 involved fatalities, 12 resulting from spins and stalls.

Tom Hardin, chairman of the board, said that this ratio of stall fatalities (about 50 per cent) is inordinately high. It has been running that way for about a year and a half. Nearly all are due to the pilots lack of skill, combined with the vulnerability of the aircraft to such behavior. Both of these factors are too frequently aggravated by show-off or reckless flying. The skill of private flyers never will equal that of professionals. Therefore, increased use of spin-proof planes, which can be built today, should be encouraged.

Several years ago Gene Vidal, head of the old Bureau of Air Commerce, made a plea for foolproof airplanes instead of the conventional "pilot's" plane which dominates private flying. His effort brought him nothing but grief. The other day Tom Hardin, chairman of the free and independent Air Safety Board, made a similar plea. Many a manufacturer and politician will writhe in pain, but, regardless of the merit of Mr. Hardin's argument, he cannot be attacked as Vidal was. He says that the Advisory Committee, for one, is working on a spin-proof plane. So the battle between the "speed" school and the "box-kite" school goes on.



Wide World

FRANCE HOPES TO USE THIS C.A.M.S.-Portez 161 on the Trans-Atlantic route next year. The 42 ton ship is being hoisted aboard a barge at Sartrouville for shipment to final assembly plant. It will carry 20 passengers.

No Man's Airport

As completion of Gravelly Point airport draws near, it occurs to Washington's merry men that no authority has been designated to run it. You will recall that, after Congress had jawed about the old field for years, our go-getting Mr. Roosevelt took over one day and said: Let there be an airport!

The civil air law puts the CAA administrator in charge of airways facilities. But what about the land and the buildings? There is the National Parks Service, which reigns over public lands in the District and elsewhere. There is the Public Building Administration, which is what it sounds like. Suppose a triumvirate of those two agencies and Mr. Hester are put in the control tower. And suppose one of them wants to have an air show and the other two would rather fly a kite. Only one thing is sure just now: something or other will be done about it.

Meanwhile, Gravelly Point will have to have a manager in the person of some one man, and some mighty important people are nominating Col. Sumpter Smith, who is superintending construction, and doing it right well.

Segregate Airplanes?

The boys (and girls) of the Private Fliers Association contend that aircraft should be divided into the same categories as pilots: scheduled, non-scheduled, commercial, private, and instruction. If adopted by the CAA, says Bill Brinckerhoff, PFA's scribe, "the way will be clear to eliminate weight classes for private fliers, and, more important, cost of private airplanes in the long run should be reduced."

Brinckerhoff also asserts that the CAA "will be obliged to simplify certification of pilots in a material way by delegating that authority to instructor pilots rerated for the college pilot training program." Aircraft, he declares, will receive certificate renewals through certain mechanics or service organizations. The PFA believes it's the only way to handle the rapidly growing number of pilots and craft, "unless by an impossibly large increase in the number of CAA inspectors."

Safety Council Gives Awards

Five airlines were given annual awards of the National Safety Council in New York. While it was emphasized that all four major lines in the Class A group, American, Eastern, TWA and United had flown the entire year without a fatal accident, annual awards went to American for having flown 633,802,388 passenger miles, now more than four years of clear record; and to Eastern for a record of having flown 213,829,314 passenger miles without a passenger fatality.

In Group B, airlines operating two million but less than 50 million passenger miles annually, Pennsylvania-Central received an award for having flown 95,516,221 passenger miles without a passenger or crew

Spot Checking

Aircraft export investigation by Congress was squelched by Roosevelt who asserts power as boss of the Army and of foreign relations. He says military secrets are being kept.

$125,000,000 airport program is proposed by Senator McCarran. It follows the NAA program. See page 79.

Bell delivers first YFM-1 twin-engine pusher to the Army, rated 400 mph.

GHQ Air Force develops light bombardment, changes from attack to medium bombers.

Three-cent air post cards proposed to Congress. All-first-class-mail-overnight, and air express are live issues again.

Second class air travel is proposed by United, which asks CAA for 25% cut on California routes; would use Boeing planes.

Washington hears Germany is launching a building program to off-set Allies' purchases of aircraft from the United States.

fatality. This remarkable record covers approximately 12 years.

Northwest Airlines received a Group B. award for having flown 38,496,471 passenger miles without a passenger fatality.

Continental Air Lines, in Group C, operating less than two million passenger miles, received an award for having flown 12,583,990 passenger miles without a passenger fatality.

Atlantic Division of Pan American Airways was given a special commendation for its 100 crossings of the Atlantic without a fatality.

For A Worthy 99er

By September, the Ninety-Nines expect to have their Amelia Earhart Scholarship Fund ready for use. The flying women of New York-New Jersey contributed their share through an aviation ball. Out in Ohio, the All-Ohio chapter held a linen and candy sale. In Minneapolis, the 99 girls raffled an airline ride for their money-raising part of the Earhart Scholarship Fund.

The fund, to provide a flight scholarship for a worthy girl, is growing.

NAA's Airport Program

Gill Robb Wilson, N. A. A.'s new president, wants his organization to sponsor a federal-state airport program. At the March meeting of the executive committee, Wilson's plan was approved by the new N. A. A. committeemen. The plan provides administration by the CAA and the division of costs between the nation and the states.

A ratio of four to one on expenses where landing areas, maintenance and navigational facilities are involved, with communities financing buildings and facilities directly related to local needs, would be worked out, under the plan, with the federal government paying the "four".

According to the N. A. A., the program would have funds allocated by the CAA through state aviation departments. It would provide for a "formula, arrived at through consideration of the populations to be served, the size and number of planes to be provided for, the relative claims of scheduled and non-scheduled operators, etc."

One of many questions discussed at the New Orleans convention of the N. A. A. in January, the program also urges the establishment of aviation commissions in states not having such bodies.

The N. A. A. also announced that May 27 and 28 will herald the 1940 National Aviation Forum. Tom Beck, New York publisher, will chairman the meeting to be held at the Department of Commerce Auditorium in Washington. An air show at Bolling Field is planned simultaneously.

Another step of Wilson's new administration is the removal of N. A. A.'s headquarters from Dupont Circle to the Willard Hotel in Washington, April 1.

Sperry Gyroscope has made a flying laboratory of its new twin-engine Lockheed; instrument panel is designed for quick interchange of instruments, and desk and work bench are provided for researchers; special cupolas facilitate astronomical checking of navigation aids.

LAGUARDIA FIELD HAS ENDED ITS FIRST WINTER. New snow removal equipment got a real workout. After one storm a million cubic yards of snow were removed from the many runways. Equipment from N.Y. City is used to supplement Field machines.

THE WASHINGTON WINDSOCK

by BLAINE STUBBLEFIELD

Airlines Raid the Air Corps

Raiding the Army for pilots is the newest way of getting them for the air lines. At least one, maybe several, flight-masters are out, doing the training stations with persuasive talks on the joys of the aerial bus business. You can always get a good pilot from the right-hand seat, but then you have to fill *that* seat. It takes a nice line of talk. Those Army boys visualize a growing U. S. air power; promotion; a tolerant pay-master; flashy equipment to fly; trips to glamorous lands; maybe a rollicking war for the swash-bucklers, if any; eventual retirement with pay.

Amendment of the Walsh-Healey Act, which now puts labor standards on public contracts of $10,000 or more, would be of no little concern to the aircraft industry, especially in this era of sub-contracting. The proposed amendments would not only blacklist manufacturers who violate the Labor Relations Act, but would reduce the $10,000 minimum to $4000 or $2000. Chances of enactment seem small though, because War and Navy Departments don't want any more interference with the procurement programs just now; and the Administration already has indigestion from the NLRB mess.

The Bookkeeping of the credit card system is getting burdensome, and traffic gossip is that a central accounting office might soon be set up to handle the job. Some sales, what with passing the passenger from hand to hand, and checking back for credit on the sale, look like low comedy in retrospect. One thing that makes the system stay put is that despite a reasonable amount of explaining, many people still think they have to ride on the line that sold them the card. An attractive misunderstanding for lines that have a lot of cards out. Incidentally, many folks still think they can borrow somebody's card for a trip; they don't believe it when told that they can't; and that makes the little pasteboards hard to sell.

People who don't need jobs can always get them. The War Department called in the National Academy of Science to make an exhaustive study of defense aircraft production, with reference to unit cost and possible plant expansion. Congress appropriated $50,000 for the purpose. The Academy was selected because it did a bang-up report on instrument landing systems for President Roosevelt. Everybody will reach for the Academy's yardstick figures when they're ready.

Word reaches here that the whole airplane attack plan of the Germans has been upset by a shift of British shipping from the North Sea and the Channel to the West coast. It's several hundred miles farther and the bomber convoy can't fly that far and back. Germany is building new light convoys that can, but the advantage will be with the British, who will meet attack with light fuel loads.

While the Allies were losing an appeal for standardization of American export airplanes on three basic designs, they had to make changes on their own production lines. Application of armor to protect crew and engine became mandatory. The armor is not very thick, but it's angled to deflect .30 caliber bullets. Military experts here interpret the armor as a tightening of opinion on expendability of pilots. Another change Europe had to make on the run was self-sealing bladder gas tanks. . . . Though .50 caliber air machine guns are being built widely, we hear there are none in battle yet, but soon will be.

Cash But No Carry

Dull times on the western front are reflected in Commerce Department reports of monthly aircraft exports of less than 250 units, while estimates of production soar towards 1,000 units per month. Answer is that planes for the Allies are being allowed to pile up at east and west coast ports. Available shipping is more urgently needed for other things, and the Allies don't relish running valuable airplane cargo through submarine-filled waters—which may be less full of submarines later. The warehoused planes are in export package—wings off but otherwise assembled; it will take about two months to get them from the west coast to the fighting fronts, and about half that from eastern ports. Flyaways, of course, could cut this time.

Another factor in the low Commerce figures is the fact that many planes are being shipped knocked down and getting their first assembly on the other side.

100,000 pilots in 1942

Chairman Robert H. Hinckley of the Civil Aeronautics Authority thinks there will be 96,000 or perhaps 100,000 persons holding pilots licenses in the United States by the close of 1942. Two years ago there were 17,700, he said, and now the total is 32,500. Mr. Hinckley predicts there may be 25,000 or 30,000 civil airplanes in the country at the end of 1942. At present the manufacturers are turning out about 400 non-military planes per month. He believes the figure may be 800 within two years—planes for domestic use. By that time, the airlines should carry 4,000,000 passengers a year, instead of the present 2,000,000.

Calling Names

Bertram W. Ainsworth, formerly with Taylor-Ainsworth, is vice president of Differential Wheel Corporation. . . . **Pennsylvania-Central Airlines'** "capital ship" Norfolk was christened March 3 at Norfolk, Va., by Mrs. Charles Edison. . . . **James Brazell,** 72, Oklahoma City, claims to be "daddy" to his state's flying; he has owned 12 ships since the twenties. . . . **A "modern pioneer" scroll** is prized by Frederick G. Hughes, g.m. of General Motors' New Departure Division. . . . **Another** of these N. A. M. "Oscars" was presented W. N. Goodwin, Jr., v. p. of Weston Electrical Instrument Company, at New York. . . . **Vultee Aircraft** chooses T. C. Sullivan, aero-scribbler for the Wall Street Journal, as its new secretary. . . . **A Bellanca Cruisair** is Bernarr MacFadden's newest ship. . . . **Furlonge H. Flynn** becomes Pratt & Whitney's new assistant service manager. . . . **Nine hours,** eight minutes for $9.36. This is the travel cost over 1000 miles for Richard H. Depew, Jr., v. p. of Taylorcraft. . . . **General Tire** names W. O'Neil, president-g. m., W. E. Fouse, T. S. Shore, C. J. Jahant, L. A. McQueen, S. S. Poor, vice presidents. . . . **Southern Aircraft** re-elects officers inciuding Willis C. Brown, president; John M. Bennett and Orin Moe, vice presidents. . . . **Delta Airlines'** new stewardess teacher at Atlanta is Miss Laura Wizark, Los Angeles, formerly with American Airlines. . . . **Pesco** names Howard Terbeek advertising manager, M. J. Phillips engineer in charge of hydraulics. . . . **"Modern pioneers"** are new citations borne by Harold F. Pitcairn, Agnew E. Larsen, Paul H. Stanley, Harris S. Campbell, Joseph S. Pecker, of Pitcairn's autogiro group for their work. . . . **C. V. "Sonny" Whitney** chairmans new Board of Liaison Officers of American Arbitration Association, to decrease commercial controversies and litigation. . . . **First-to-fly-the-Atlantic,** Capt. Albert C. Read is new commander of the Naval Flying School at Pensacola. Read flew the NC-4 in 1919. . . . **For outstanding contribution** to transoceanic air transport safety, Robert J. Minshall, Boeing v. p., has the Musick Memorial trophy for 1940. Australia, England, and the U. S. made the award. . . . **J. B. Templeton,** v.p., Templeton, Kenly & Co., Chicago, becomes president, succeeding W. B. Templeton, now board chairman. . . . **Assistant General Sales Manager** of Timken Roller Bearing Company is William H. Richardson's new title. . . . **H. E. Weihmiller,** Consolidated Aircraft's v. p., since 1937, resigns; was at one time Washington representative of the company. . . . **The CAA buys 12 new Piper "Cub"** coupes; Air Safety and Inspection sections will fly them. . . . **An extension of the controls** made it easy for Bobby Draper, 80-pound Boston Midget, to learn to fly. Draper is three and one-half feet tall. . . . **American Airlines** elects two regional vice presidents: H. R. Thompson at Los Angeles, and Reed G. Landis, Chicago. . . . **Sarasota,** Florida stages its "first annual, non-stop, refueling competitive air marathon;" Chamber of Commerce promotes the show. . . . **Alex L. Robb,** formerly with R. & R. Mfg. Co., Pasadena, has been named development engineer for Interstate Aircraft & Engineering Corp., El Segundo, and will undertake a program emphasizing engineering of aircraft hydraulic units. . . . **William H. Lewis,** comptroller and director of Douglas Aircraft Co., has resigned of his own volition to develop his private interests. Herman P. Grube, treasurer, has temporarily assumed the duties of Mr. Lewis. . . . **Robert E. Gross,** and other Southern California aviation leaders, recently joined in honoring Major Alexander P. de Seversky on the occasion of presentation to him of the Pacific Aviation Club Trophy for his East-West record transcontinental flight of 10 hr. 2 min. 55-7/8 secs., Aug. 29, 1938. . . . **Hollis B. Thompson,** city manager of Berkeley, Calif., since 1930, has been elected regional vice president of American Airlines, Inc., with headquarters in Los Angeles, according to C. R. Smith, president.

Albert H. Stackpole, editor-in-chief The Harrisburg Telegraph, is elected a member of the board of directors of Kellett Autogiro Corporation.

George A. Smith, formerly with New Departure at Meriden, Conn., becomes assistant g.m. of General Motors' hydra-matic division. **Beckwith Havens,** Fairchild distributor at Mineola, N. Y., becomes commander, Aviation Commandery, Naval Order of the U. S. **Arthur Nutt,** is President of the S. A. E., engineering vice president of Wright Aeronautical Corp., Patterson, N. J. **S. J. Zand,** consulting engineer for Sperry Gyroscope Co., becomes vice president for S.A.E.'s aircraft engineering section. National Association of Manufacturers appoints **John C. Gebhardt,** National Economy League's exec. dir., as director of research. **Jay Irwin** is Chicago district manager, steel and tube division, Timken Roller Bearing Company; formerly Chicago salesman.

DEFENSE

Expansion for Navy None for Air Corps

The House took only one day to debate and pass the Naval Expansion bill and send it over to the other side of the Capitol. This bill provides no money, but simply authorizes the Navy to increase the size of the surface fleet and air force.

Opposition is expected to be stronger when Congress gets around to talking money. At present, however, the bill gives the Navy the power to:

(1) Acquire 4500 aircraft instead of 3000, and 12 lighter-than-air craft instead of 8. This means 1011 new planes and 4 new blimps at an estimated cost of $99,152,270. An amendment changed the wording of the bill so that the Navy may buy "not more than" the numbers set, instead of "not less than", as recommended by the Naval Committee. The Navy now has 2050 planes delivered, and 8 blimps on hand or on order.

(2) Augment the surface fleet, including 3 new aircraft carriers. Vigorous attempts to strike out this part of the bill were defeated.

In thus expanding, the Navy must observe all existing procurement laws, such as the 12 per cent profit limitation and labor standard requirements.

The House decided to limit the expansion program to 2 years rather than 5 as originally planned, on the theory that world conditions are changing too rapidly to allow a more long-range scheme. This bill represents the first 2 years of the 5-year plan which would have cost about $175,000,000 for aircraft alone.

The Army meanwhile has asked for no further expansion of the Air Corps, but requested an extra $20,000,000 to cover increased plane costs. Maj. Gen. Henry H. Arnold, Chief of the Air Corps told Congressional leaders that plane deliveries are coming in fast enough to assure completion of the program by July 1, 1941, although production of engines over 1000 hp is lagging.

At the start, he said, 3500 new planes and 5500 new engines were needed, plus an additional 1500 of each for replacements. Only 186 airplanes are still to be procured of the 3219 for which funds were advanced last year. Continuous experimentation on improved models is being maintained.

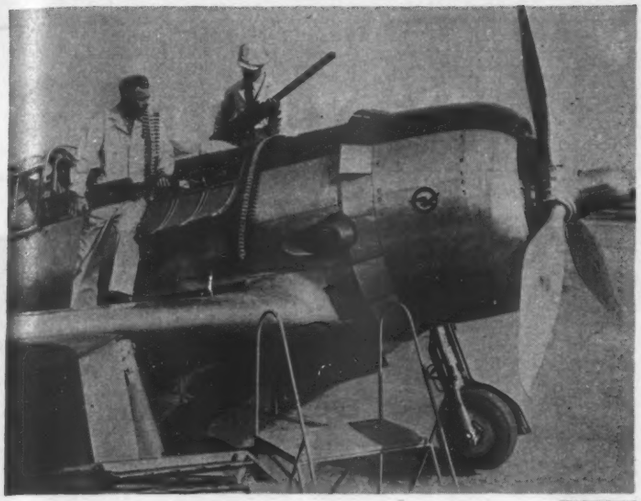
Both the Army and Navy may now speed up aircraft procurement by awarding contracts for planes and parts to second and third lowest bidders as well as first. But—only until July 1, 1941, and only if completion of national defense programs appears otherwise impossible.

This privilege is granted under the Harter multiple contracts bill which passed the Senate last summer and recently slipped through the House during routine consideration of pending legislation. "Quality, times and rate of delivery, price, and the prevention of overloading of a plant or plants" must be considered when either Department decides to exercise this power.

The Army had hoped for the right to negotiate contracts, but Congress refused to aban-

International

CHIEF INSTRUCTOR OF THE ARMY AIR CORPS, Capt. H. C. Claiborne, Flying Cadets at Glendale, Cal., explaining his Tri-Dimensional Traffic Pattern to Capt. K. P. McNaughton, Commanding Officer at the field. Device shows cadets maneuvers they are to make.



Wide World

THESE AREN'T EXACTLY PEA-SHOOTERS that are going into the nose of the Vultee Vanguard. Claimed the "heaviest armed" ship in the world, six .30 caliber guns are in the wing and two .50 calibers fire through the prop. 5000 rounds of bullets are carried. Two 20 millimeter cannons can replace the six .30 guns.

don the competitive bidding system. This bill represents a compromise. Actually, officials now say the status of deliveries is such that multiple awards will probably not be necessary. Still they are pleased to have the authority just in case.

Delivery Begins On P-38's

The United State Army will shortly receive its first unit of a $10,000,000 order for the fastest interceptor pursuit planes in the world. Lockheed, despite record foreign military orders, and large commercial orders, is ahead of schedule on delivery of the new P-38 type fighters to the U. S. Army Air Corps. This is the plane which won Army approval last year following a record transcontinental flight which proved the plane capable of extended operations at speed above 400 mph., the elapsed time being 7 hrs. 45 min. 36 secs.

Sign Up Now, Cadets

WASHINGTON (AVIATION BUREAU)—Traveling Flying Cadet Examining Boards are about to start on a tour of various corps areas to enroll candidates for remaining large classes. General Arnold, Chief of the Air Corps, announces that 400 cadets will be needed every six weeks until the class entering late in September. After that the size of classes will be reduced. The class of March 27 was filled up with little difficulty. Gen. Arnold says that the youth of the country is beginning to appreciate the opportunity of training for an aviation career.

College men who have accumulated only half the credits necessary for graduation are eligible, but the Air Corps encourages them to finish school. Candidates must be between the ages of 20 and 27, unmarried, in good physical condition; no previous flying experience is necessary. Application for appointment is made to the nearest Air Corps station, to the nearest Corps Area headquarters, direct to the Chief of the Air Corps in Washington, or to the Traveling Boards—when they get on the road.

Edison Okays Dirigibles

WASHINGTON (AVIATION BUREAU)—Since the Navy alone is now active in lighter-than-air, Secretary Edison concludes that the national interest is entitled to a statement of policy. Mr. Edison was asked to testify on airships at hearings on the naval expansion bill, but he declined, asking permission to submit later a report which was then in preparation.

Here are the leading conclusions reached, briefly stated: For five years the lighter-than-air situation in the Navy has been static, or getting worse. This has been a handicap to the Navy, but it has also discouraged commercial development. The United States has a great advantage in its helium monopoly. Non-rigid airships should be built for coastal patrol. Rigid airships should be built for Navy needs, to train personnel, to aid commercial development. While airships can be built safe, there are aeronautical improvements which can now be adopted.

Drilled Lamicoid Terminal Insulators for landing light circuit

. . . ready to help solve your insulating problems

AIRCRAFT and accessory manufacturers who are familiar with the dielectric features of a laminated plastic will find vast possibilities in the *extra* advantages of Lamicoid.

1. Permits complex punchings.
2. Holds a smooth, clean-cut edge.
3. Low moisture absorption and power factor.
4. Easily threaded and drilled.
5. Threads do not chip or fracture.

Costly rejects are banished... flawless fabrication made positive when insulators are stamped or machined from Lamicoid. These facts have been proven time and again by critical buyers of insulation.

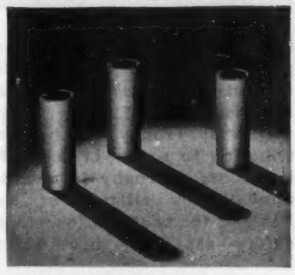
We want you to prove this for yourself. If you do your own fabricating, Lamicoid is available in sheets, rods and tubes in all grades and thicknesses.

Send for samples of stock or fabricated parts which you need in your own work.

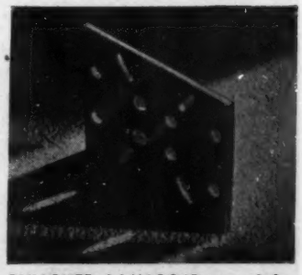
Mica Insulator Company

200 Varick St., New York; 542 So. Dearborn St., Chicago; 1276 W. 3rd St., Cleveland. *Branches at* Birmingham, Boston, Cincinnati, Los Angeles, San Francisco, Seattle. *Canada:* Montreal, Toronto.

Send for Samples



STATIC SHIELDS for spark plugs cut from Lamicoid tubing



PUNCHED LAMICOID panel for instrument insulation

LAMICOID CONDENSER COILS, drilled and punched, for short-wave radio work

AVIATION PEOPLE

ROBERT J. MINSHALL, vice-president in charge of engineering of Boeing Aircraft, was awarded the Edwin Musick Memorial Trophy for his contribution to safety of ocean flying boats. Trophy is awarded annually by citizens of New Zealand for contributions to air safety—especially boat safety.

LEWIS YANCEY died of cerebral hemorrhage on March 2. "Lon" will be greatly missed by his many friends throughout the world. After a long line of aeronautical exploits, he added further to his fame by being navigating officer of the Consolidate Flying Boat "Guba" on its South Seas flights.

DONALD R. ELDRIDGE, new assistant to the Superintendent of Operations, TWA. Formerly a Flight Superintendent at Kansas City, Eldridge is also a skilled meteorologist and will continue research in weather work. He is a Naval Academy graduate, has done advanced work at Harvard and M.I.T.

LIEUT. COL. A. M. DRAKE, for the past three years in charge of Air Corps Procurement in Detroit, has been promoted to Senior Officer of the new Central District Planning Division for Industrial Mobilization at Dayton and will work closely with Wright Field personnel on plans for a possible "M" day.

LIGHT-PLANE MEN GET TOGETHER. Under chairmanship of vigorous Tom Beck, Crowell-Collier Publishing president and rapidly becoming aviation's staunchest backer, leaders in the manufacture of small airplanes and engines got together in Cleveland recently for first of a series of meetings. L to r, seated: J. H. Torrens, Luscombe Airplane Corp.; W. T. Piper, Piper Aircraft; W. A. Mara, Stinson; Tom Beck; A. Wild, Continental Motors. Standing: J. Story Smith, Jacobs Engine; Richard E. Palmer, Lycoming; L. D. Lyman, United Aircraft; Robert E. Fowler, Aircooled Motors; A. T. Pinney, Porterfield Aircraft; Carl Wootten, Aeronca; Richard H. Depew, Taylorcraft. Following the meeting Mr. Beck reported a production gain last year of 110 per cent, and 30 per cent gain in licensed civilian pilots. Many fine things are expected to come from this new organization. Most firms represented face a great expansion.

JOHN CLEMSON of TWA has become Regional Manager at Pittsburgh, since that city has become a regional office. Clemson has been in transportation work many years, was with TAT until TWA was formed. He just completed two years as District Traffic Manager for TWA in New York City.

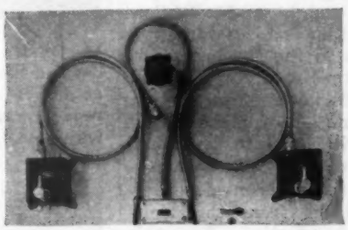
LOOK TO BREEZE for DETAIL ENGINEERING

Just as the strength of any chain is determined by the weakest link, so a number of small elements may determine the value of an airplane in service. Vital to performance are the radio ignition shielding, tab controls, electrical connectors, junction boxes, fuel-air ratio indicators, tie rods, and the multitude of accessories that contribute as much to the safe operation of the ship as the basic design itself.

For many years, Breeze has engineered just such parts for aircraft use. Specialization, and the highest type of precision manufacture, have enabled Breeze to offer an exceptionally complete line of aircraft and engine accessories that have the background of successful operating experience.

Aircraft designers today look to the Breeze list for the answer to many of the important problems that must be solved before a good installation is possible.

BREEZE MARK



The Breeze Exhaust Gas Analyzer, for single or multiple-engine installations, is engineered to give a fast, accurate fuel-air ratio indication based on the measurement of the thermal conductivity of exhaust gases.

Radio Ignition Engine and Auxiliary Shielding • Spark Plug Radio Shieldings • Multiple Circuit Electrical Connectors • Flexible Shielding Conduit and Fittings • Conduit Junction Boxes • Cartridge Engine Starters • Dichromatic Cartridge Containers • Internal Tie Rods • Propeller Pitch Controls • Elevator and Rudder Tab Controls • Flexible Shaft and Case Assemblies • Aeroflex Jr. Flexible Instrument Lines • Tachometer, Fuel Pump and Remote Control Drives • Ammunition Rounds Counters • Radio Tuning Units • Generator and Ignition Filters • Engine Primers, Single or Multiple • Fuel and Oil Tanks • Exhaust Gas Analyzers (Fuel-Air Ratio Indicators) • Flexible Tubing of Stainless Steel, Aluminum, etc. • Resistance Type Thermometers • Swaging Machines and Tools.

Stainless Steel Division: Pioneers in the design and development of stainless steel structures and fabricated products.

NEWARK **BREEZE** CORPORATIONS, INC. NEW JERSEY

AVIATION ABROAD

War's Effect On Design

Looking over some British opinions on where we are now, and where we're going in aircraft and engine design, doesn't lead you to expect any startling changes in the near future. As might be expected, they're almost entirely concerned with military types. Under aerodynamic improvements, nothing is said about the possibilities of new low-drag airfoil sections, but the British, like everyone else, are known to be working on them.

The experts feel pretty well satisfied that the modern single-engined fighter is just about the end of the line in cleanness. On multimotored ships, however, they see a big chance to gain speed by finding some way of getting the engines inside. Engines specially designed to be flat enough to fit into the average wing haven't been heard of so much lately, but in France at least one (a Bugatti to turn out 1,500 hp.) is being worked on. One suggestion is to put the motors in the fuselage and drive wing propellers through shafts and gearing, which would add plenty of weight and complication. Another is to use a couple of engines in the fuselage driving counter revolving tractor props in the nose. Anyway, they agree, some better place to put motors will have to be found than where they are now.

Structures are considered almost entirely from the viewpoint of production. For this reason single-spar wings are praised as long as too many holes don't have to be put in forward of the spar. The two-spar wing is regarded as about the best present practice, taking into account the number of things that have to be stuck in a wing nowadays, ease of production, and the good support it furnishes for flaps and ailerons. Multispar wings are condemned as too hard to make, particularly since a lot of their theoretical weight saving over other types is lost by openings and joints.

The biggest field for progress pointed out is that of standardization of details, and possibly even of design practice for whole assemblies throughout the industry. The numerous fancy shapes of rolled and extruded sections, for example, could probably be cut down to a few standard sections in various sizes, without running up structural weights enough to notice. With such standardization, production of aircraft shapes could be speeded up, and costs and the necessity of carrying big stocks reduced. As an example of standardized design practice, the outer wing panels of multi-engined ships could probably all be made the same way. The panels could be made shorter or deeper or wider as required by different airplanes, but all would have the same general design and the same types of parts.

Engine designers don't seem to be quite so willing to use standardization.

Airline Replacements

One of the biggest problems now facing both neutral and belligerent airlines, is where they are going to get replacement ships. Besides the toll of a loss now and then, the progressive lines don't want to sit back watching their ships go down hill from normal wear and tear and obsolescence. The neutrals have so far been able to find plenty of manufacturers looking for business, but they're up against increasing pressure from the competition of military orders, and in cases where they're forced to import their ships, usually have trouble in persuading their own governments to spend foreign exchange for such luxuries as commercial planes.

The countries at war have been variously affected. The Germans have made out about the best as far as ships go; Lufthansa was pretty well supplied at the beginning of the war, and even though a good many of them aren't so new, they have a lot of good sturdy airplanes with lots of hours left in them. Besides, routes and frequencies have been reduced on both domestic and foreign lines to no more than is really needed. This was particularly easy and painless for Germany, which had no world empire or distant pals with whom it was necessary to maintain fast communication. In spite of these reductions, the Germans claim that Rangsdorf, which has replaced Tempelhof as the commercial field for Berlin, is Europe's busiest airport.

The British were certainly hit the worst. They were already suffering from an acute airliner shortage when the war began; most of their routes were too important in the scheme of empire communication to permit much reduction in service; work on new commercial ships was suspended, and then to finish things off, the government took over some of their remaining fleet for what they considered more urgent jobs. The Air Ministry is getting a very bad press from those who feel it hasn't stood up for the airlines strongly enough, but they don't seem to have much hope that anything will be done until it's too late. How hard the British are scraping the bottom of the barrel is shown by the recent loss of the ancient Hannibal on the way back from India, a veteran that certainly deserved a more happy and peaceful old age than it received.

The French, who were in a better spot in that they had just about completed a big landplane equipment program when the war came along, have made a move toward insuring a supply of commercial ships. A new company said to be capitalized at 300,000,000 francs has been set up, apparently under or at least in a close tieup with Air France, to turn out transport ships for operation on the airlines.

Authenticated News

SCHIPOL, AMSTERDAM'S AIRPORT, continues to be busy despite the war. The Dutch are operating lines between neutral countries and also between neutrals and beligerants. France recently approved KLM ships passing over French territory on way south.

British Press Combine

AN EAST END VIEW GOING WEST of a British Short "Sunderland" Flying Boat. The four gun turret, being out of the main slip-stream of the fuselage, allows exceptional firing accuracy which has given German attacking planes no end of concern.

tomorrow's plane...

will demand even greater

stamina and dependability

from materials and equipment.

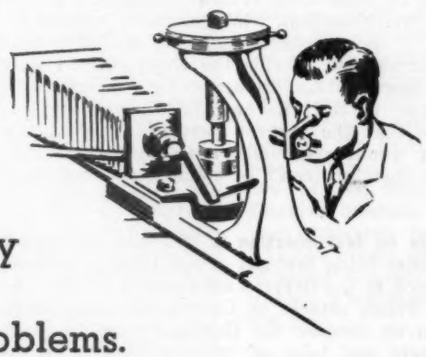
and tomorrow's control cord...

will fully meet these increasingly

exacting requirements,

for Roebling Research is busy today

with tomorrow's aircraft control problems.



JOHN A. ROEBLING'S SONS CO.

TRENTON, N. J.

KEEPING PACE WITH AN INDUSTRY WHOSE WATCHWORD IS PROGRESS

AS OTHERS FLY IT

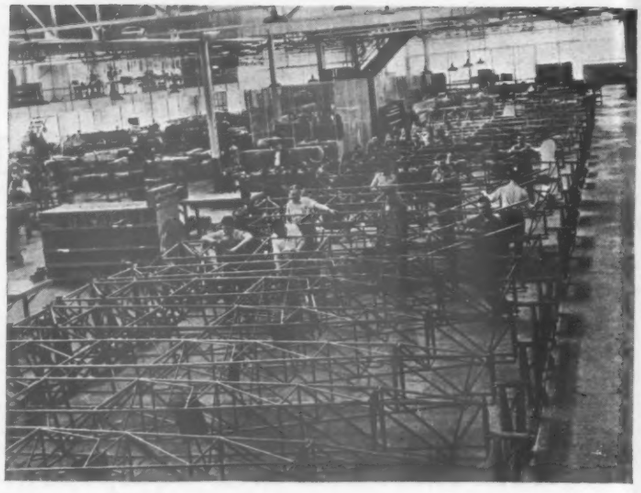
Nazis Take Off with Ether

Don't forget that the Italians are still in the export business. As the only European neutrals with a big time aviation industry they're in a nice spot to turn about as much business in military and commercial ships as they want to take on. One country they've been going after in a big way lately is Japan. The recent goodwill flights back and forth between them is being followed by Italian-organized exhibitions in the large Japanese cities and even in Manchukuo. The Japanese have already thrown them some business, such as the Savoia Marchettis for the Tokyo-Bangkok line mentioned here earlier. There's been a lot of talk recently about Belgium's plans to place some military orders there; she's been one of Italy's steadiest customers for commercial ships. Another story is that Norway, which already has some Bredas, will swap a big load of codfish for military planes.

Italy's biggest export opportunity is of course in selling to the boys already in the war, but down that alley there are plenty of political bumps. The British aeronautical press has recently been running little notes on how the Italians are pretty near and build very nice airplanes and aren't such bad fellows after all—all of which has smelled like building up the home folks for news of substantial orders with them as part of the big commercial agreement that's been expected for some time. It looks now as if they intended to, but that Mr. Mussolini, while perfectly willing to send them plenty of such products as garlic and olive oil, drew the line at armament. Beside the obvious hitch that this might have been a little embarrassing in view of Italy's official position in the international lineup, there is the rumored one that the biggest part of the deal was for engines that would eventually have wound up with the French, who certainly can't be counted as loyal Mussolini rooters.

Another angle on fuel injection in German engines comes from the stories being brought out of Poland by those who had a good look at the German air force in action. According to them Polish attacks on German-occupied fields were often broken up because the Germans used to jump into parked fighters and take off without hanging around to warm up their engines. Captured Messerschmitts, according to this version, were found to have two small auxiliary tanks that made this stunt possible. For starting, which is done electrically, a mixture of ether and gasoline is injected, which gets things going in a hurry. Then the pilot switches over to another tank with a mixture of gasoline and lubricating oil, and takes off right away. After he's been going long enough for his engine to come up to temperature, he switches over again to draw on his main fuel tanks. With this system the Germans are said to have made full throttle takeoffs with cold motors as a regular routine practise, but the Polish stories also claim that they had plenty of trouble with their fuel injection pumps, which demanded a lot of maintenance under service conditions.

There are signs that the French are loosening up a little on letting neutral lines into France. There's no talk of letting them run clear across the country, but they'll evidently be allowed in far enough to shorten considerably the surface travel stretches now required. SABENA, which had its whole connection between Belgium and the Congo knocked out, has finally received permission to come north into Marseilles. It will run in pool with Air Afrique, each line sending out a round trip per week. KLM is also said to be in line for permits that would lop a day off the present Amsterdam-Naples train ride. In the north, according to these rumors, the Dutch would be allowed to fly as far as Dieppe on the coast, while in the south they could come over from Naples to Marseilles, leaving only the trip across France to be made by rail.



THE LARGEST PEACE TIME ORDER for training planes has been claimed by the Stearman Aircraft Division of the Boeing Airplane Company. In addition to the order for PT-13B primary trainers for the Army South American orders are also coming in.

Foreign Markets

J. Russell Hancock, Ltd., 49 Courtenay Place, Wellington, New Zealand, is interested in representing manufacturers of aircraft and accessories. They cover all of New Zealand and have a branch in Melbourne, Australia, operate on a commission basis only, representing well-known manufacturers, such as Thermoid Co., Trenton, N. J., Weaver Mfg. Co., Springfield, Ill., Brunner Mfg. Co., Utica, N. Y., David Coe, 75 West St., New York City.

Casa Americana Ltda., Apartado Postal 1208, Loanda, Angola, Port, W. Africa. Importers and Distributors. Established in 1924, stated capital $20,000. References: General Motors Overseas Corp., 1775 Broadway, New York City, U. S. Rubber Export Co., 1790 Broadway, N. Y., Pittsburgh Plate Glass Co., Newark, N. J., Shaler Co., Waupun, Wis.

Jos. Avonds, Emiel Verreesstreet 19/21, Turnhout, Belgium, would like to be placed in touch with manufacturers of aircraft and aircraft supplies. Established in 1904, stated capital $111,000. References: Diamond T Motor Car Co., Chicago, Cleveland Welding Co., Cleveland, Guaranty Trust Co., N. Y. (Antwerp Branch).

West Coast Business

Sweeping additions have been made to the staff of Vega Airplane Co. as that firm expands its activities, according to announcement of H. E. Ryker, general manager.

Approximately $100,000 in new equipment has been added to Vega Facilities, and personnel has been expanded from 400 to about 700 men. Current backlog is in excess of $2,500,00.

Despite deliveries at a rate in excess of $100,000 per month, compared to $62,000 monthly during 1939, the backlog of Solar Aircraft Co., San Diego parts manufacturer, has jumped to an all-time high of $1,250,000 acording to Edmund T. Price, president.

Aircraft Accessories Corp., Glendale, Calif., has achieved a 400 per cent increase in its production facilities through purchase of the completely equipped machine shop of the C. H. Q. Securities, Inc., located near its present plant.

Recent Awards

Navy Department

Sperry Gyroscope Co., Inc., Brooklyn, $950,136 for automatic pilots; and units.

Wright Aeronautical Corp., Paterson, N. J., $95,135 for airplane engines and spare parts.

Grumman Aircraft Engineering Corp., Bethpage, New York, $16,976 for spare parts.

United Aircraft Corp., East Hartford, Conn., $211,017 for services and material and to furnish aircraft engine and conduct tests.

War Department

Hayes Industries, Inc., Jackson, Mich., $121,343 for wheel and brake assemblies.

Goodyear Tire & Rubber Co., Akron, $74,720 for wheel and brake assemblies.

United Aircraft Corp., East Hartford, Conn., $272,359 for spare parts for Pratt & Whitney aeronautical engines.

Bendix Aviation Corp., Bendix, N. J., $54,504 for energizer assemblies.

United Aircraft Corp., East Hartford, Conn., $319,725 for propeller assemblies and sets of controls.

AVIATION MANUFACTURING

Foreign Policy Governs Aircraft

The Administration is making the aircraft industry into a powerful instrument of national policy. Congressmen get only brief glimpses of the procedure by which the Administration moves toward that end. Therefore, Capitol Hill is suspicious. And it is suspicion that is setting off all the fireworks about release for export of advanced airplane types and about the cost of war planes for home defense. Sensational stories of altercations between the military, the Treasury, and the industry are partly true but are not important, except that the facts work into the open as one side tattles on the other.

What Congress will find, if it probes below the surface, is a well-coordinated policy, built around three objectives:

1. Help the Allies fight the war by sending them enough planes to overtop Germany—maybe 2,000 to 3,000 a month.

2. Make the Allies pay for the creation in this country of the biggest aircraft production plant in the world—a plant which will ultimately give this country a terrific leverage in questions of war or peace.

3. Maintain the superiority of our own air force by holding back our most advanced models except to the extent necessary: (a) to prevent the Allies being outclassed by the Germans; and (b) to keep the Allies from looking to other sources—Italy or a new Canadian industry—for airplanes.

It was the last point that precipitated the excitement. Release for export of new models is the responsibility of the Army-Navy Joint Aeronautical Board, and it is a delicate business. The military swear that they have at no time violated the established policy that no model be released until a better one is under contract; thus the P-40 has been bettered by Curtiss' own P-46. But this is a policy susceptible of some interpretation. The Allies are, in a general way, dependent on us for planes, but they aren't going to buy stuff that's plain obsolete.

If they have to, they can get ships elsewhere. Italy now probably isn't turning out more than 250 planes a month, but if the material were available the capacity is there for something approaching 1,000. The British have kept the material away from them because they don't trust the Italians, but maybe a deal could be made. And, while it would be slow and heartbreaking, an industry could be built up from the ground in Canada—a thing we want to avoid at all costs.

And above all, the Administration has no intention of getting so tough as to really hurt the Allies.

Point 1—maximum production—is the responsibility of Secretary of the Treasury Morgenthau, acting as informal representative of the President. He is making sure his tax policies put no obstacles on expansion and is also taking a hand in such internal troubles of the industry as the engine bottleneck. Morgenthau thinks he has set the engine problem on the road to solution by initiating the priority agreement on machine tools, but as of now it is still serious. Best current estimate of aircraft production, civil and military, is 1,400 a month, while the same authority estimates engine production at 1,100 units per month; and remember lots of planes have more than one engine.

Point 2—making the Allies pay—is being left, with a benevolent smile, to the self-interest of the manufacturers. But even here some government intervention enters. Witness, the three-type plan. The scheme was to concentrate a new $1,000,000,000 of Allied orders on three firms—probably Douglas, Martin, and Curtiss—with the lucky three sub-contracting what they couldn't handle. It had got as far as the making of verbal commitments when the Army put its foot down and insisted that nothing be done which would freeze production and stop experimentation.

Meanwhile, however, before you cross off the three-type plan, watch the negotiations on the new orders and see how many companies actually do get big orders.

DOWN TO 50 DEGREES BELOW ZERO is the temperature to which the new Hamilton Standard Test House can be lowered. The new house has been designed to tackle the problems that are presenting themselves with taking planes into the substratosphere.

Curtiss-Wright Merger

On March 19 a proposed merger of the Curtiss-Wright Corp. and the Atlas Corp. was announced by the two firms. The plan announced was to transfer Atlas Corp's. $36,500,000 general market securities to Curtiss-Wright in exchange for its stock and to vest the $25,000,000 special investments of Atlas in a new company. Combined value of the two companies' stocks was about $160,000,000.

The continuing company will be called Curtiss-Wright Corp. and there will be no change in management. As a result of the merger, CW increases its capital by about $36,500,000. This new money is expected to strengthen its position in the industry and substantial savings in corporate organization are expected to follow.

Announcement of the two firms stated that it is possible that Wright Aeronautical Corp., which is a 97 per cent subsidiary of Curtiss-Wright, may be included in the merger. Stockholders are expected to vote on the merger early in April.

Douglas 20 Million Dollar Order

Out of the welter of words over the Allies alleged scheme to place a billion dollar order with the American aircraft industry came one concrete action early in March with placing of a $20,000,000 order with Douglas by the British government. This was particularly significant because of the fact that major recent buying has been done by the French. The order was believed to involve about 200 of the fast twin engine Douglas bombers such as have been delivered to the French. The new planes will be improved in many respects and are said to have a top speed in excess of 350 mph.

Freight Rates Fight

Aeronautical Chamber of Commerce went into battle on March 18 to keep railroads from raising freight rates on planes, engines and other aeronautical equipment. New rates proposed would cost the aviation industry some $4,000,000 additional in freight rates in next 12 months. Freight rates on airplanes would be increased 25 per cent or more and on engines at least 300 per cent. Railroads seem to be eager to get part of the money coming to this country from the Allies for armament expenditures.

Liberty Aircraft Products Corp. has taken over the plant and business of Kirkham Engineering & Mfg. Company of Farmingdale, Long Island, following the resignation of Chas. B. Kirkham. The new corporation will continue the aircraft and engine parts sub-contracting business which has reached large proportions. Robert Simon continues as president.

MEET YOUR INCREASED PRODUCTION with this

HPM

NEW 1000 TON FASTRAVERSE AVIATION PRESS

This moderate size H-P-M Press assures accurate forming of modern aviation parts, with fast, shockless controlled operation, and its easy die set-up will amaze you. » »

Maximum Tonnage	1000
Pressing Surfaces	72"x48"
Daylight	36"
Ram Travel	36"
Horse Power Required	40

Write for complete specifications

THE HYDRAULIC PRESS MFG. CO.
Mount Gilead, Ohio, U. S. A.
District Sales Offices:
New York, Syracuse, Detroit and Chicago.
Representatives:
Boston, Worcester, Hartford, Pittsburgh, Akron, Cleveland, Cincinnati, Flint, Seattle, San Francisco, Los Angeles.
Foreign Representatives:
Canada, England, France and Holland.

AVIATION ENGINEERING

Pilots Report Preferences

Overwhelming preference for tricycle landing gear for airliners was exhibited in returns from a recent pilot questionnaire circulated by the market research division of the Lockheed Aircraft Corporation. Even those pilots who had never operated a tricycle gear equipped airplane voiced a certainty that it was the proper design for future use. "I think it a mistake to build anything else" was a typical reply. While only 23 per cent of those returning questionnaires had ever operated planes equipped with tricycle landing gear, 89 per cent of the answers expressed preference for the type of landing equipment which was in common use before 1912, according to J. V. Sheehan, Lockheed market research manager. The vote was 60 per cent in favor of the nose wheel being made steerable by rudder pedals, as against free swivelling. But the pilots could not make up their minds on brakes, 51 per cent saying they should be on all three wheels and 49 per cent on the two main wheels only. However, 69 per cent thought the nose wheel brake, if used, should be independent of the main wheel brake control, and 72 per cent felt the nose wheel brake control should be regarded as an emergency brake only. The questionnaire also covered every conceivable problem of the flight station, engine control stand, rudder pedals, control column, instruments, radio, power plant, and the airplane in general. Final results will be made available to the industry later this year.

Strato-Clipper Supercharger

The "Flying Cloud," the new name given to the Boeing Stratoliners by Pan American, is about to go into regular service. But inside the ship is a cabin pressurizing device which solved a problem that caused many an engineer in the industry to use descriptive words not yet described in Webster's best unabridged edition.

In each of the two inboard nacelles is located one of the superchargers being driven off of the engine. On the leading edge of the wing, one on each side of the fuselage is located a circular hole approximately five inches in diameter where the air entering the intake side of the supercharger is supplied. When the ship is flying at an altitude that does not require supercharging a special vent bypasses the air from the intake pipe back to the outside again. After being supercharged the air passes through conduits and is distributed to the cabin through small grills located just above the floor level along the sides. The air of course is heated and contains the correct amount of oxygen.

All parts such as doors and windows have been designed to hold at least a pressure of 2½ pounds per square inch inside the cabin. The passenger door, incidentally, opens inward rather than outward to facilitate maintaining the pressure.

FOR MORE ACCURATE WIND TUNNEL RESULTS the Boeing Aircraft Co. built themselves a $16,000 model of their new Stratoliner. Eddie Allen, Boeing's Director of Flight and Research, personally took charge of the proceedings from start to finish. Photographs are taken of recording instruments during tests.

$16,000 Boeing Model

One of the important details in the development of the Boeing Stratoliners that has gone by practically unnoticed is the complete working wind tunnel model.

The 307 research model is just one-tenth the size of the actual airplane, which has a wing span of 107 feet, 3 inches, and a length of 74 feet, 4 inches. Built in the Model Department of the Boeing Wood Shop, the miniature Stratoliner has wings of laminated mahogany, and tail and control surfaces of maple. The four engine nacelles, each housing a compact 5-horsepower electric motor, are machined out of cast dural and the motors drive 13.8-inch three-bladed propellers, at speeds up to 20,000 revolutions per minute.

Inside the fuselage of the model are two more small electric motors which operate the rudder, elevators, ailerons and wing flaps. During a test run in the wind tunnel, researchers can move any of the surfaces by remote control. Each change in position of the control surfaces, including the deflection caused by the force of the wind is automatically and accurately indicated on the central instrument board along with other pertinent test data.

Standardization Meeting

The Eastern Aircraft Standardization Committee, composed of engineering representatives from the Curtiss Aeroplane Division, Glenn L. Martin Co., Brewster Aeronautical Corp., Kellett Autogiro Corp., Stinson Aircraft Division, Bell Aircraft Corp., Grumman Aircraft Engineering Corp., Vought-Sokorsky Division, and the Republic Aviation Corp., met on Tuesday March 19, at the Republic Aviation plant in Farmingdale, L. I. The meeting furthered the movement in the east to establish standardization methods in the industry of airplane parts.

To do this the Committee investigated new means of reducing airplane costs and facilitate production by inter-company exchange in the design and purchase of various fittings, rivets, bolts, and similar parts. The next meeting of the group will be in April at the Bell Aircraft Corporation plant in Buffalo, N. Y.

THE CABIN SUPERCHARGER for Pan American's "Flying Cloud" is located one on each of the inboard nacelles. Outside air enters through the pipe in the center, is raised in pressure and is forced into the cabin (pipe at the lower left).

TRANSPORT AVIATION

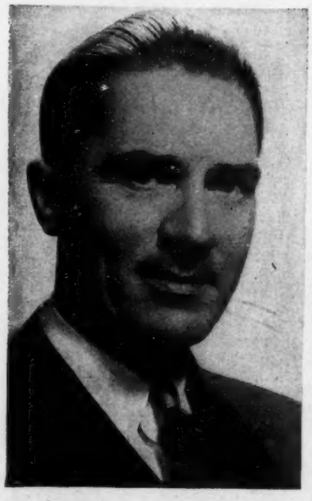
10 Instrument Stations

Ten instrument landing stations on the airway system will be well along toward completion and experimental operation in the Spring of 1941. The 25 cities named as eligible are in the order of priority, and unless their airports, upon further consideration, are found to be unsuitable, or unless some of them fail to develop airport plans now under way, the first ten on the list will get the installations.

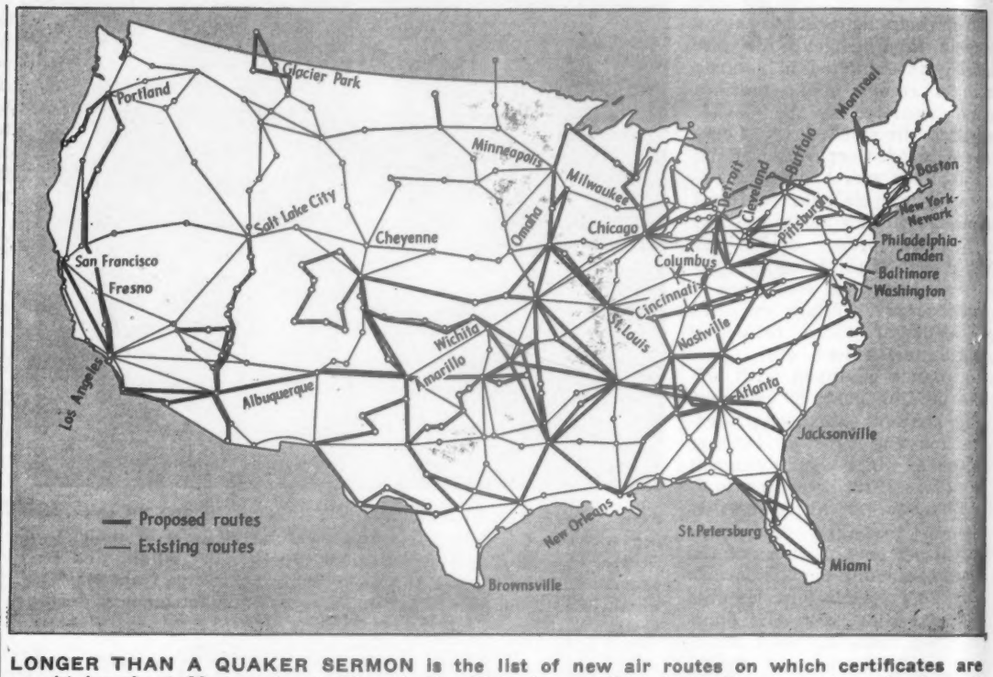
First ten on the list, not necessarily in order of preference, are: New York; Cleveland; Chicago; Oakland; Los Angeles; Seattle; Washington, D. C.; Atlanta; Fort Worth; and Kansas City.

Unsuitability of a port of course means obstructions. Railroads, towers, poles, buildings, hills in the line of approach and take-off—even such as can be tolerated in contact manuevering—are definitely out so far as instrument work is concerned.

Civil Aeronautics Authority is drawing up specifications of equipment, following recommendations of the National Academy of Sciences, and eventually will call for bids. All manufacturers will be eligible. Portable equipment will be used to test all sites. Radio experts now incline to believe that permanent installations will be stationary, because most locations have fairly constant wind directions, and because few can boast a clear track in more than one direction. But others argue that portable equipment is superior: they say instrument landing cannot be practical until it can be used all the time, in all wind directions, in which case two portable sets (one stand-by) would be much more economical than sets at the ends of all runways. Certainly the military will use portable equipment.



ANOTHER REGIONAL Vice President for American Airlines is Reed G. Landis who will hold down the Chicago office for his line. He is a World War flyer and Chicago business man.



LONGER THAN A QUAKER SERMON is the list of new air routes on which certificates are sought by about 30 operators. Though the Civil Aeronautics Authority was set up in August, 1937, it is only now beginning to approve new runs. Every decision takes heavy thinking. The law sets up a system of air monopolies—under control. There shall be competition, but not too much in the wrong places. Where is that invisible center of gravity? The map shows how the system would look if all applications were approved. See story "Proposed New Routes" directly below.

The airlines are having fun announcing, as United did, that a large proportion of the ten units will be on *their* lines. Of course those same stations will be on other peoples' lines too, so if you add them up from news releases you'll get ten-ten-double-ten.

Proposed New Routes

The proposed new routes total about 75, foreign and domestic. There are dozens of little ones everywhere like Westfield, Mass. to Albany, N. Y. Among the big-leaguers is American Airlines' application for Detroit to Toronto; Northwest, Chicago to New York via Detroit; Toronto, Buffalo; Pan American, Seattle to Juneau, Los Angeles to Mexico City, and another one straight across the Gulf to Merida, Mexico, and Guatemala; United Air Lines, Boston to Cleveland via Hartford; Western Air Express, Great Falls, Mont. to Lethbridge, Canada—denial recommended by examiner. In the foreign field the records show U. S. to France via Botwood, Newfoundland, Foynes, Biscarosse and Marseilles; New York to Biscarosse and Marseilles. A big enterprise in a few words by American Export Air Lines. And there's New York and Bermudan Airline applying for Newark to Bermuda, hearing set for April 22. Some folks say this one is a promotion scheme, but in a democracy even the devil is heard in court.

Down south they are really blowing hats off. There's a long series of applications in—like Denver to San Antonio, Amarillo to Atlanta, Denver to Atlanta, San Antonio to El Paso, Memphis to Houston, Memphis to Kansas City, Denver to Kansas City, Cincinnati to New Orleans, and so on. Braniff, Chicago & Southern, Continental, Delta, Eastern Mainland, Kansas City Southern, are all in there pitching. Of course some of the applicants don't expect or desire approval at this time. They are just staking out claims. But operators attitude has changed since last year. Many of them, before and for a time after advent of the Authority, were afraid of losing their pants on feeder lines. So was the Post Office. Most of the applicants now actually mean business.

The other day C.A.A. examiners recommended rejection of United's application for a cluster of towns in the Sacramento Valley. Their reasoning was that cost to the government, over and above postal receipts, would outweigh the public service. This is probably precedental for similar cases. Observers say there is still no airplane exactly suitable for service on the proposed feeders. They say that if four-engined equipment is adopted widely on main lines, present two-engine equipment would go on the feeders. In which case feeder airport facilities would become a worse problem than they are now. Interest is renewed in the airport program.

Summer Travel

Undoubtedly air transport's summer season all-time high is coming up. The international smart set, which has the dough, and is for the first time in the history of aviation barred from gadding about Europe, will see America—many of them also for the first time. But though the traffic curves will go through the ceiling, they would go higher but for an unfortunate circumstance. That misfortune, the experts tell you, is an imminent shortage of equipment. And, like the old lady who had no tea and no sugar to put in it, the lines might not have the pilots if they had the airplanes. Vacationers will start booking themselves any day they see a robin now, and many a v. p. in chg. traffic will cry in pain as through the summer he must tell the waiting line his show is fresh out of seats.

AIR TRANSPORT INDICATOR

March 1, 1940

170.09

Which is the ratio of passenger-miles reported by the Air Transport Association for all domestic lines for February, 1940, to the figure for February, 1939. Total for the Indicator has increased greatly over the last month and still remains far ahead of last year. For the first two months of 1940 traffic stood at 108,467,490 revenue passenger miles—up 65.5 per cent.

See Finance page for individual companies' traffic figures.

NEW REGIONAL VICE PRES. for American Airlines: Hollis R. Thompson. He will make his headquarters, and his home, in Los Angeles. He is former City Manager of Berkeley.

Airline Shorts

Northwest Airlines company officials amended NWA's application filed with the CAA asking for permission to establish a transcontinental line from Seattle to New York via the Twin Cities, Chicago, and Toronto. Amendment asks that Detroit and Buffalo be stops on the proposed line.

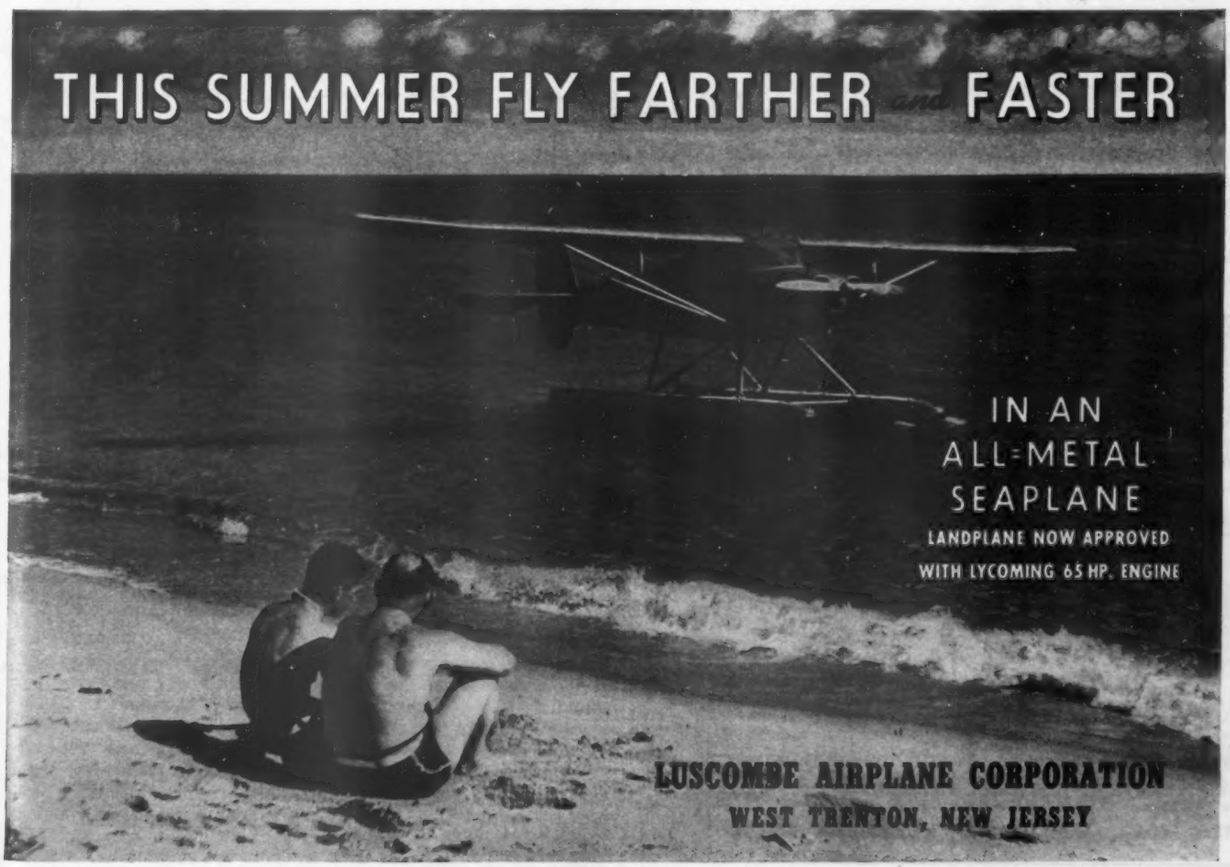
Braniff Airways is operating a third round trip schedule daily between Chicago and Dallas, Texas. The line's new Douglas DC-3's are being used. The line has a new training school for women traffic personnel, at Oklahoma City.

Eastern Airlines put eight Douglas DC-4's on its New York-Miami; Chicago-Miami; New York-Brownsville; and New York-Washington runs. Delivery of the craft will begin in 1941. Cabins will be supercharged. At night, as a sleeper plane, the Douglas will carry 20 passengers. A crew of six officers and men will handle the ship. A flight-engineer will supervise operation of the craft in flight. EAL has started DC-3 sleeper plane service, New York to Brownsville, Texas.

TWA also goes for chimes instead of buzzers to summon hostesses. The line installs new type cylinders and pistons on its Wright engines to effect a more uniform distribution of lubrication and temperature. Heavier heads and increased number and depth of fins on the sleeves provide additional cooling surfaces. The system expected March operations to show a 27 per cent increase over its March 1939 schedules. Two additional Kansas City-Chicago flights, and two additional flights into Fort Wayne, Ind., are now operated.

American Airlines inaugurates sleeper plane service from Boston to Los Angeles with "The Southerner", originating each morning in Boston and arriving in Los Angeles early the next afternoon. A new one-stop, Boston-Chicago service, via Buffalo, and a new non-stop Detroit-Chicago flight are added.

Canadian Colonial Airways takes delivery this spring of two new DC-3 21-passenger transports for use on its New York-Montreal route. The ships will be powered by Wright Cyclone engines with full-feathering hydromatic propellers, will have two-way radio.


THIS SUMMER FLY FARTHER and FASTER
IN AN ALL-METAL SEAPLANE
LANDPLANE NOW APPROVED
WITH LYCOMING 65 HP. ENGINE
LUSCOMBE AIRPLANE CORPORATION
WEST TRENTON, NEW JERSEY

AVIATION FINANCE

Further large orders for military aircraft and heavy transport traffic foretell 1940 profits for aircraft and airline companies well above the record levels disclosed in the 1939 financial reports now being released. Increased shipments reflect completion of plant expansion begun last fall by aircraft and accessory companies, while another airline seeks new capital to finance recently ordered equipment.

Plan for the first major financing by Braniff Airways were revealed when the company filed 150,000 shares for registration. A stockholders' meeting was held late last month to approve an increase in capitalization and a four-for-one split of the present shares. Of the 150,000 shares registered, 100,000 will be sold by the company and 50,000 shares by T. E. Braniff, president. Proceeds will be used to purchase equipment. F. Eberstadt & Co., New York, is the underwriter.

Piper Aircraft financing totaling 33,290 shares, was twice oversubscribed the offering day, according to J. E. Swann & Co., bankers for the company. Piper backlog of orders is now in excess of 400 planes.

Consolidated Aircraft directors have decided not to make a dividend payment for the present, in order to retain company funds within the business and avoid issuance of additional stock. Unannounced foreign orders amounting to $7,000,000 were recently received for an export version of the "PBY" bomber used by the Navy. Backlog includes $20,000,000 in flying boats for the Navy, and $12,000,000 in four-engine bombers for the Air Corps.

Republic Aviation's president, W. Wallace Kellett, estimates 1940 deliveries will exceed $10,000,000. Company earned the first qaurterly operating profit in its history in the last quarter of 1939, netting $88,518. Net sales of $739,177 reflected, among other deliveries, shipment of pursuit planes to Sweden.

Dividend declarations so far this year include 50¢ a share by Curtiss-Wright Corp. on its class A stock and $1.75 on the preferred shares of Air Associates. Also common share payments of 50¢ by Bendix Aviation, 12½¢ by Air Associates and 10¢ by United Aircraft Products Corp.

United Aircraft's annual report explains that the cost of recent plant in the Pratt & Whitney division is substantially covered in the selling price of products sold to foreign purchasers. It is anticipated that these plant additions will be charged off or covered by reserves at or before completion of foreign orders now on hand. Upon restoration of normal operating conditions, depreciation charges are expected to be little, if at all, heavier than they were before the additions were made.

Aeronautical Corp. of America had net sales of $654,322 for the first 9¾ months of 1939, as compared with $472,887 in all of 1938 . . . Lycoming Division of Aviation Manufacturing Corp. has an order for 500 engines from Piper Aircraft . . . January sales of Menasco Mfg. Co. totaled $42,894, as compared with $29,000 in December 1939 . . . Liberty Engineering (formerly Kirkham) reports 1939 sales of $851,787, as against $483,817 in 1938 and a year-end backlog of $600,000 . . . Fairchild Engine & Airplane has called all outstanding $6 convertible preferred at $107.50 a share . . . January sales of Thompson Products were the highest of any month in the company's history . . . The city of Cleveland boasts 72 aircraft parts manufacturers . . . Barnard Aviation Equipment has sold 60,000 shares of stock at $1.65 a share to provide working capital for additional equipment and expansion . . . Passengers accounted for 73.6% of Eastern Air Line's total revenue in 1939, as compared with 69.4% in 1938, while the mail percentage decreased from 26.8 in 1938 to 22.8 last year . . . Pan American Airways stockholders exercised their rights to subscribe to all but 5,000 shares of the 525,000 shares recently offered.

With the Airlines*

Company	Revenue Passenger Miles					Revenue Passengers					Revenue Miles Flown*		Express Lbs. Carried*	
	February		%	2 Months		February		%	2 Months		12 Months		12 Months	
	1940	1939	Gain	1940	1939	1940	1939	Gain	1940	1939	1939	1938	1939	1938
American	15,119	8,854	82	a 17,771	a 10,719	38,737	20,881	85	a 45,939	a 25,032	19,119	15,284	2,732	2,144
Boston & Maine	.....	.....	.....	.....	.....	.....	.....	.....	a 1,437	a 950	723	672	31	24
Braniff	1,890	1,054	79	3,748	2,294	5,874	3,403	72	a 5,666	a 3,794	3,487	2,692	285	266
Chicago & Southern	588	424	39	1,252	866	.....	.....	.....	3,139	2,107	1,765	1,442	116	83
Continental	.....	.....	.....	a 201	.....	.....	.....	.....	a 657	.....	943	616	16	11
Delta	.....	.....	.....	a 606	.....	.....	.....	.....	a 2,430	.....	1,588	1,398	62	47
Eastern	13,500	8,256	64	24,940	15,897	22,600	14,125	60	43,600	.....	10,981	8,266	1,140	837
Inland	.....	.....	.....	a 134	.....	.....	.....	.....	548	.....	1,008	805	24	14
Mid Continent	.....	.....	.....	a 299	a 176	.....	.....	.....	a 1,173	a 799	1,174	1,095	56	51
National	427	194	120	750	.....	.....	.....	.....	1,499	.....	716	411	21	14
Northwest	2,230	839	166	5,694	2,154	5,022	1,932	160	10,319	4,623	5,148	5,068	416	283
Penna Central	1,313	968	36	3,142	1,981	7,788	5,561	40	18,277	11,278	3,473	2,917	587	383
T. W. A.	6,197	3,548	60	13,130	7,756	.....	.....	.....	a 14,836	.....	12,038	9,808	1,114	675
United	9,354	5,629	66	19,037	11,756	.....	.....	.....	a 19,132	.....	17,724	16,531	2,406	2,078
Western Air	728	384	89	1,443	.....	.....	.....	.....	a 2,076	.....	2,266	2,308	361	312

* Last three figures omitted. (a) 1 month. All current figures subject to final adjustment.

Current Earnings Reports

Company	Period	Net Income		Common-share earnings		Sales		Back-log	
		1939	1938	1939	1938	1939	1938	Latest	1939
Aero Supply Co	Year, Dec. 31	$138,500	$109,425	$0.28	$0.21	$1,254,505	$1,069,774	$1,019,000	.....
American Airlines	Year, Dec. 31	1,467,751	213,262	4.84	.74	.....	.....	.....	.....
Beech Aircraft	3 months, Dec. 31	d 72,556	d 33,023	.....	.....	.....	.....	1,736,000	$1,279,000
Bellanca	Year, Dec. 31	d 206,262	172,646	.....	.99	.....	.....	.....	.....
Consolidated	Year, Dec. 31	1,104,326	1,535,110	1.79	2.55	3,603,239	12,245,067	49,000,000	42,141,000
Eastern Air Lines	Year, Dec. 31	883,824	354,249	2.06	.85	.....	.....	.....	.....
Ex-Cell-O Corp.	Year, Dec. 31	872,382	437,677	2.21	1.11	6,608,151	4,298,192	.....	.....
Irving Air Chute	Year, Dec. 31	381,829	361,177	1.93	1.83	.....	.....	.....	.....
Republic	Year, Dec. 31	d 524,781	d 653,366	.....	.....	.....	.....	15,055,000	11,663,000
Thompson Products	Year, Dec. 31	1,232,199	435,241	3.90	1.33	15,570,893	10,682,313	.....	.....
T. W. A.	Year, Dec. 31	d 188,827	d 749,355	.....	.....	.....	.....	.....	.....
United Aircraft	Year, Dec. 31	9,375,436	5,426,276	3.53	2.05	51,161,599	36,800,000	127,004,000	.....
United Airc. Prod.	Year, Dec. 31	104,712	71,340	.77	.53	.....	.....	1,220,000	.....
Western Air Express	Year, Dec. 31	74,556	d 12,531	.18	.....	.....	.....	.....	.....

(d) deficit.

PROFIT & LOSS

And Now More Plant Expansion

By Raymond Hoadley

Mr. Hoadley will be very glad to answer inquiries regarding the financial outlook of listed aviation companies.

If the British and French are really serious about placing a billion dollars' worth of new aircraft orders in this country in the next few months, further substantial expansion of plant and equipment will be necessary in the aircraft industry. A number of companies can produce foreign military orders for reasonably early delivery, but the capacity still available runs in the tens of millions rather than hundreds of millions. If the Allied governments place orders that will more than double the present $725,000,000 backlog on the books of American aircraft manufacturers, there will have to be plant expansion all along the line. These new plant and equipment programs, if undertaken now, will be financed from abroad and will consist largely of temporary facilities. The industry does not intend to saddle stockholders with overbuilt plants to depreciate and be maintained after the war. New war order contracts involving expansion will be financed as many were last fall, when the industry took the first steps to prevent a mushroom—and in the end profitless—war order boom.

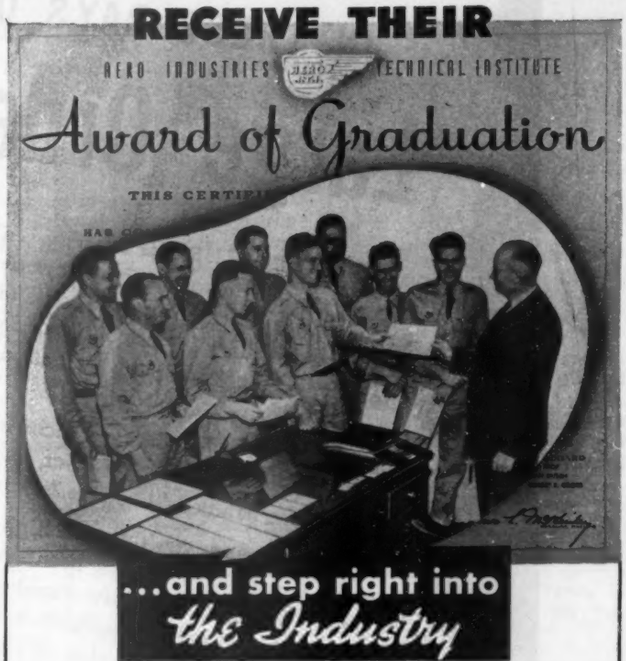
A $20,000,000 attack bomber order from the British Air Ministry brings the unfilled orders of Douglas Aircraft above $100,000,000, a mark passed by only two other companies, Curtiss-Wright and United Aircraft. Combined backlog of these three companies is now one and a half times the 1939 sales of the entire industry, and includes a substantial amount of business for delivery in 1941. The Douglas Company probably has fewer current production problems than the majority of plane builders as its last major plant additions were completed nearly a year ago. It is also in the enviable position of having almost fully depreciated the costly development of its latest big transport, the DC-4. The next exploit of this company in the transport field may be a commercial adaptation of the secret six-engine bomber now under construction.

The 1939 financial reports of the aircraft companies reveal many instances where record earnings were enjoyed, and serve as good "curtain raisers" to the excellent profit prospects for the industry this year. Penalties on late deliveries, due to a possible inability to get new production lines in full operation on schedule, appear to be the one hazard to a banner year in most cases. First quarter earnings will not serve as a criterion of the earning power potentialities of succeeding quarters.

Favorable passenger traffic figures for the month of February, and 1939 earnings statements showing substantial gains over the previous year, brought increased stock market activity and several new all-time high prices for issues in the airline group last month. American and Eastern Air Lines reported record profits, the latter operating in the black each month last year for the first time. TWA showed a wide improvement over 1938 and is picked to make further marked gains this year. Wall Street statisticians point to the air transport companies as the most shining example of growth stocks to be found today.

The annual reports to stockholders of the aviation companies, generally speaking, have been models of comprehensiveness and clarity that might well be emulated by other industrial companies. This year United Aircraft has gone a step further and issued an attractive booklet which briefly describes the past and present activities of this company and gives the reader a glimpse into the future. Eastern Air Lines has issued a separate report to all members of the EAL family, depicting in a colorful way with graphs and charts the company's progress over the past eleven years.

MORE AERO ITI MEN RECEIVE THEIR



...and step right into the Industry

This has long been the usual order of events in the progress of Aero ITI-trained mechanics and engineers. At Aero ITI carefully selected young men receive an industry-wise training. They graduate equipped with practical knowledge of, and practical ability in, the manufacturing and maintenance processes actually in use in Aviation.

As a result, the Industry has readily accepted Aero ITI-trained men...has employed hundreds immediately upon completion of their training. From this, Aviation executives can judge how well trained, how dependable, Aero ITI men have demonstrated themselves to be.

Further information on Aero ITI training sent on request

AERO INDUSTRIES TECHNICAL INSTITUTE
5261 West San Fernando Road, Los Angeles, California

Five Courses in AIRCRAFT MECHANICS and AERONAUTICAL ENGINEERING including U. S. Civil Aeronautics Authority Approved 12 Months Aircraft Mechanics Training

EXECUTIVE BOARD

C. A. VAN DUSEN, Vice-Pres., Consolidated Aircraft Corporation
JOHN K. NORTHROP, President, Northrop Aircraft, Inc.
ROBERT E. GROSS, President, Lockheed Aircraft Corporation

These leading Aviation industry executives supervise the policies and operation of the Aero Industries Technical Institute.

CAPACITY IS IMPORTANT IN THESE DAYS OF

Large Orders

MANUFACTURING capacity is a vitally important factor in these days of greatly expanded aircraft production. Thousands of gallons of Berry Brothers Aircraft Finishes are now being sold where only hundreds of gallons were once sold.

Berry Brothers production facilities have kept pace with the industry however, and today, large orders are handled "in stride."

More important yet, the same high quality standards which have always been characteristic of Berry Brothers Aircraft Finishes, are rigidly maintained. Intensive research is carried on continually to produce finishes of still greater durability—and all production materials are repeatedly checked to make sure that they conform to the highest possible standards of quality.

Detailed information regarding any Berry aircraft material may be had promptly upon request.

BERRY BROTHERS

DETROIT, MICHIGAN — WALKERVILLE, ONTARIO

BERRY BROTHERS · SKY-TESTED QUALITY · BERRYLOID

BERRYLOID

AIRCRAFT FINISHES

AVIATION OPERATORS CORNER

Operator Advertising

Operators who have felt the need for spending a few dollars a month on newspaper advertising but who have not known how to prepare their copy can now solve their problem for $5 a month. An advertising man, Norman Warren, 452 Fifth Ave., New York City, has organized the Fixed-Base Operators' Advertising Service. He sends operators four ads a month for $5, with a minimum period of six months. He supplies mats and all operator pays in addition is for newspaper space. Advertising copy is bright and sparkles with interest.

AIRPORT
Can You Drive a Car?
Then You Can FLY A PLANE
THERE is no mystery about a flying plane. There is nothing about it that calls for "nerve" or courage. There is no need for special abilities of any kind.
If you can drive a car, if you can play a fair game of tennis, or ride a horse, and if you are in normal health, then you can learn to fly a plane—unquestionably the most thrilling sport of all!
Plain everyday folk, of every age, and from every walk of life, are earning their pilot's licenses every day of the year—discovering a new way to enjoy life to the full.
Wouldn't you like to join them? You'll be amazed at how simple and economical flying really is. Let's have a little friendly chat all about it some day this week!
YOUR NAME HERE

Soaring continued to show evidence of vitality in Southern California as the spring months approached, with their favorable flying weather. A soaring meet at Torrey Pines, San Diego, on March 3-4, brought out 17 sailplanes, 35 soaring pilots, and about 2,000 of the general public. John Robinson won the meet with a flight of 2 hr. 25 min. The following weekend an impromptu meet at Palos Verdes, Los Angeles County, found several pilots in the air for from four to five hours at a stretch. A feature of the meets at both Torrey Pines and Palos Verdes was that the number of sailplanes in the air made traffic a real problem and a flagman on the ground was kept very busy indicating, among other things, minimum altitude from which a safe approach and landing could be made at the point of take-off.

The spring meet at Arvin, Kern County, is expected to set a new record in interest, performance and attendance. At least 30 sailplanes are expected to contest for more than $1250 in prize money. Sailplane manufacture is progressing rapidly with both Bowlus Sailplanes and Briegleb Aircraft Co. in regular production on kits; while various individual sailplanes are under construction by groups and individuals.

Crash Kits

For the first time an operator can now get all the items he needs for emergency equipment complete in one kit. Until now an operator or school had to buy equipment such as bandages, fire extinguishers, and asbestos gloves piece by piece and assemble them together for himself. Now an enterprising company is making up the complete kit.

The Davis Emergency Equipment Company, working closely with Aero Insurance Underwriters, has put out a package designed especially for the one and two-hangar airports. Included are two first aid kits, a small one for minor shop injuries and a larger crash kit for serious shop injuries and for crashes. The shop kit contains antiseptic solutions, bandage compresses and adhesive compresses.

The larger crash kit has first aid equipment, fire extinguishers, asbestos suit, gloves, helmet, an electric lantern and a strong metal hook attached to a chain.

Since more than 60 per cent of private aircraft accidents occur at or adjacent to airports, an operator with proper equipment can often perform efficient service following a crash if he is prepared for it. Often the first problem following a crash is fire. One or more carbon dioxide or dry compound extinguishers should be available.

First aid equipment is an absolute necessity. The Davis kit is specially designed to take care of the burns, abrasions and fractures that often follow crashes. The kit contains enough burn ointment to cover two or three bodies, large bandage compresses and triangular bandages for large wounds, wire splints adjustable for leg or arm fractures, a tourniquet, tweezers and proper scissors.

Airports

Bremerton, Washington, will no longer be the largest city in U. S. without an airport. This summer WPA will clear and level a 230 acre field and build a modern hangar. Indicative of increased aviation activity in all parts of the country, the old TAT field at Clovis, New Mexico, idle since 1930, was put in condition and on March 11th flight training began once more. The 580 acre field was purchased through private subscription in a Chamber of Commerce campaign.

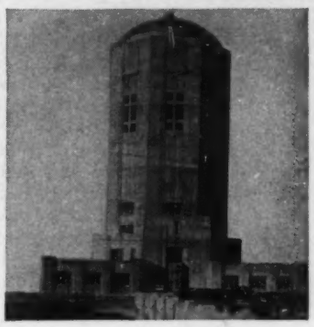
Texas Aeronautic Association began its ground and flight instruction in Austin recently. Ground courses were opened at the Univ. of Texas and for the public at the Austin Public Library. On basis of competitive examinations, 15 hour flight scholarships will be awarded. Courses are for benefit of Texans not eligible for CAA flight training program.

Distribution of Stinson Aircraft in Southern California has been taken over by the Stinson Flying Corp., recently organized with Leo Cox as president; Ted Lynn, vice-president; John R. West, treasurer; and Nathan Newby, secretary. The company plans a chain of eleven dealers in the Southern California area and will seek to apply automotive merchandising methods to the marketing of airplanes.

Daytona Beach, Florida, officials thought their airport was large enough for DC-3s, and it took a ride in an EAL DC-2 to convince them that the larger ships could not be safely accommodated. One trip was enough to bring change of plans.

Lake City, Fla., has employed Floyd B. Simmen to manage its municipal airport. He used to manage field at Marion, Ind. Simmen will operate a ground and flying school.

All Florida is out to get the factory which Monocoupe Aircraft Corp. says it will build in the State. In the hope that one factory will draw another, every Chamber of Commerce is rooting for its own town. Clare Bunch of Monocoupe is looking them over. His St. Louis plant has been sold and he wants a site that will permit all-year operations in warm weather.



TOWN OF LAKE, Wisconsin, built this fine water tower and equipped it as aerial beacon. With its brightly illuminated red lamps and flashing red beacon it is a landmark for all pilots in the Milwaukee area. Beacon is 162 ft. above the ground. Building is floodlighted. Lower section of building provides space for city hall, police station and garage. Town is to be commended for its far-sightedness.

Our census taker working over in New Jersey tells us that Al Bennett, of the famous Hightstown Bennetts, sold 115 new airplanes last year and 47 used planes. Up to middle of March this year he had sold nine new planes, had deposits on eight more, plus selling ten used planes. On his day off Al promotes the Bennett plan.

By unanimous vote the Los Angeles City Council has adopted and sent to Mayor Fletcher Bowron, an ordinance creating a Municipal Airport Commission of three members to be selected by the Mayor and confirmed by the Council. The Council will retain authority to approve leases and rates at the airport.

Los Ang. Aviation Day

A step toward establishment of a national "Aviation Day" has been taken by the Los Angeles County Board of Supervisors. Such a day would be set aside as a memorial to aviation pioneers who have lost their lives in blazing new air trails. P. G. B. Morris, president of the Early Birds, has been appointed to head a committee outlining plans for such a memorial observance.

Grand (Air) Central

Plans of the Airlines Terminal Building in New York's Grand Central hot spot have been changed to give the five operator tenants two floors instead of one. One floor will be used by incoming passengers, the other by outgoing. Only last year the terminal corporation thoughtfully concluded that one floor would serve for many years. Now, in a few months, the estimate is doubled. What further change may be necessary before long, no one can say. You can find imaginative persons who think the air terminal might some day handle more people than Grand Central does now.

So many mushroom aviation schools sprang up in California recently that the aviation committee of the Los Angeles Chamber of Commerce conferred with the industry and issued a report condemning them. Manufacturers agreed there was no need for schools of the job-training type, giving narrow training for one specialized line.

REPORT CARD

Of Air School

Safair of Roosevelt Field, Long Island, now has 140 lusty students from six colleges who are clammering for flying time under the CAA Flight Training program. This is the largest CAA unit in the East. These students, plus others from Mathews & Rappaport, keep Roosevelt Field busier than it has been in years.

Another Eastern flying school with a busy gang of college students is White Flying Service, at Caldwell-Wright Field, N. J. Lowell White reports he has 40 students from Newark, Montclair and Paterson. Ed. Gorsky at Bendix Airport is teaching 50 CAA students to fly plus his regular students.

Boeing School News has just printed its 15th article on Aeronautical Occupations. This has been a splendid series and has attracted so much favorable comment that the school plans to reprint them in a single booklet.

Columbus University Jr. College in Washington, D. C. has been approved by CAA for ground instruction in that area. The 72-hour course has already attracted over 300 students. Capt. C. P. McDarment, formerly of the Army Air Corps, is in charge.

Earl Southee, who is director of Region I of the Civilian Pilot Training Program. From his base at Roosevelt Field he supervises 92 college groups and 24 non-college groups, and a total of over 100 operators.

More than one thousand students under full-time instruction in the Curtiss-Wright Technical Institute shops and class rooms, is shown by the latest report by Major C. C. Moseley, president. The Army recruits and the civilian students work side by side in many courses, demonstrating the great value of qualified private schools to the national defense of the country in time of emergency. A major problem of the school has been provision of adequate space, instructors, and equipment. With factories draining the industry of men, jamming the airports with planes, and placing orders far in advance with machine tool manufacturers, the Curtiss-Wright staff has found it necessary to design and build many items of equipment right in the shop. This serves the dual purpose of getting the tools as needed and reducing the peak load on equipment manufacturers.

Among all the training schemes and rumors of training schemes for foreign pilots that have been flooding the country, comes one from Palo Alto, Calif., alleging that a proposal to train 200 Swedish airplane pilots at Stanford University has been made by Dr. Yangeve Zotterman to Ray Lyman Wilbur, president of the university.

TAGGING THE BASES

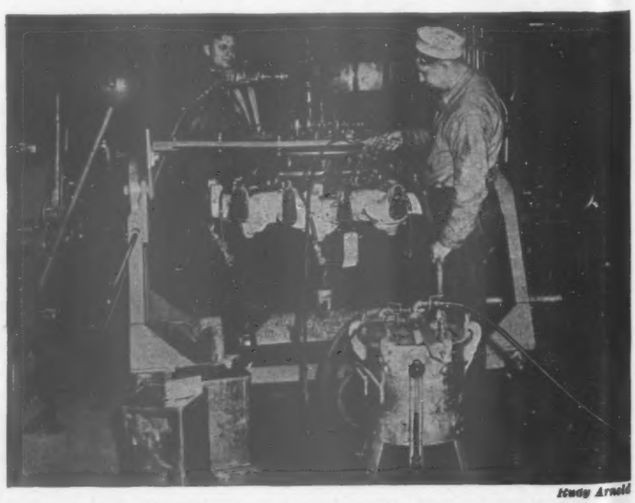
with LES NEVILLE

Children's Day Pays Dividends

Many a mother wonders what to do with Johnny when school is closed on Saturdays. Popular solution is to send him to the movies. But Philadelphians have a new wrinkle. They pack up a nice lunch for the offspring and send him to spend the day at the Rising Sun School of Aeronautics. There Saturday is children's day and the idea pays dividends. Most of the visitors have older brothers, cousins, or someone who would like to learn how to build and maintain airplanes. And experiences has proved that they do just that. Rising Sun rolls show many cases of several members of the same family taking courses simultaneously or in succession. It certainly pays to entertain the younger generation.

There's a human side to this school business too. The kick you get out of placing students is a never ending source of satisfaction. One operator told us about a personable young lady who came into his office one day all smiles and waving a letter which she insisted he read. It was from her husband in Cheyenne, who had been graduated from the school and placed in U.A.L.'s shops. Enclosed in the letter were airline tickets to Cheyenne for the rest of the family, and instructions to come on and set up housekeeping there. The aviation industry had taken another step toward building up what depression had torn down.

You can save money by "multiple maintenance" in the same way manufacturers do in "quantity production" and now is the time to do some thinking about it. With light planes being ground out at a great rate and one-ship operators daily becoming "fleet owners", there are many opportunities for maintenance efficiency and economy. The Private Flying Division of C.A.A. has developed forms and procedure for light plane maintenance and many operators are finding them useful. It would be a good idea for everyone to read about them in the story on page 38.



Rudy Arnold

U. S. COAST GUARD has developed this compressed air motor to turn over its airplane engines while engines are being sprayed internally to prevent rust and deterioration during storage. The small motor is expected to save considerable hand labor.

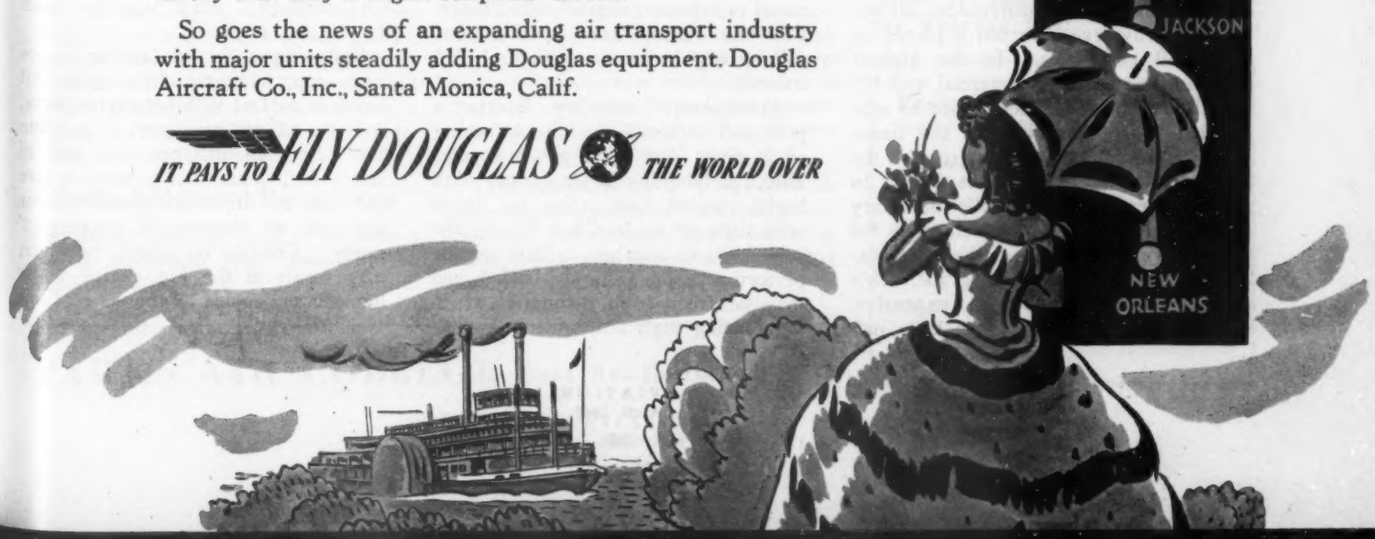
CHICAGO & SOUTHERN GOES DOUGLAS!

Introducing a brand new luxury fleet of Douglas DC-3 21-passenger transports May 1, Chicago & Southern Air Lines improves a service already famed for efficiency enhanced by friendliness.

Flying the direct "Valley Level Route" between Chicago and New Orleans, C&S offers winged access to every important city of the Mid-West and South in the comfort, security and luxury that only Douglas Airplanes afford.

So goes the news of an expanding air transport industry with major units steadily adding Douglas equipment. Douglas Aircraft Co., Inc., Santa Monica, Calif.

IT PAYS TO FLY DOUGLAS THE WORLD OVER



Gasoline

(*Continued from page 57*)

rigidly enforced that any improvements, except an increase in octane number, are virtually impossible.

There is a surprising similarity between current commercial specifications for gasoline and those set by the Oil Division of the U. S. Fuel Administration as far back as 1918. The old specifications did not include knock ratings, but a comparison of other items with similar items in airline specifications reveals a startling sameness. Volatility is of particular importance. The 1918 specifications were for airplane engines of that day, naturally aspirated, poorly manifolded and with no intake air heaters. Modern engines with their high compression, high blower pressures and temperatures and means for distributing the charge do not require the same type of fuels and there are good reasons why they would operate more satisfactorily and efficiently on fuels of quite different characteristics.

Present day fuel specifications may be divided roughly into two classes: commercial and military. The published work of Hubner, Egloff and Murphy points out the differences of opinion regarding satisfactory commercial fuel. While the reasons for these differences is appreciated, the necessity for reducing unnecessary operating costs is ample reason for reviewing and liberalizing the commercial specifications for the purpose of minimizing the number of grades required.

Military specifications differ in certain essential details from those either now in airline use or proposed by the C.F.R. They differ from commercial in that they provide more latitude in volatility, use a different method of determining knock-rating and define different tetraethyl lead limits.

Because of these differences, an unnecessarily severe burden is placed on the oil companies. In the highest octane grades, 95 commercial and 100 military, the same fuel cannot be supplied to both services as the limits on tetraethyl lead content require the production of two distinct fuels. In other grades it is usually necessary to manufacture a fuel which meets the most rigid of any of the specifications for that particular grade. This procedure is obviously expensive. Furthermore, there can be little justification for differences between military and airline specifications when the fuel is used in the same kind of engines.

A single set of specifications should be acceptable to both military and commercial consumers. Specifications should include only those items that have been proven to measure the service performance of the fuel and for those items the limit established should be as liberal as the tests demonstrate to be practical.

Consider volatility. It is a measure of the ease with which an engine will start, the uniformity of distribution between the various cylinders, the danger of carburetor ice formation, the maximum charge density obtainable within the cylinder with a given manifold pressure and sufficient heat supplied to just suppress ice formation, and, in certain extreme cases affords additional information on vapor locking not furnished by vapor pressure alone. Without going into details it may be pointed out that fuels of lower volatility tend to decrease ice formations and lower vapor-locking tendencies. In the unexplored field of synthetics it is possible that new compounds will be found in the higher boiling range that have knock ratings well above straight iso-octane, a material which can be used only within definite limits as a component of present high octane gasolines because of prevailing volatility specifications.

Consider knock-rating and tetraethyl lead content together. It is claimed that neither of the present knock-rating methods adequately predicts performances of all fuels in all engines. Perhaps not, but until a new and more significant method is developed—as is now being investigated by C.F.R.—is it too much to ask that one method be adopted by all consumers of aviation gasoline? It is believed not, when it is realized that one of the main obstacles has been the apparent under rating of highly leaded fuels in laboratory tests, particularly the A.S.T.M. test, as compared to full-scale engine performance. For this reason some specifications call for high minimum tetraethyl lead content.

Atmospheric humidity exerts a profound influence on the knocking of a given fuel in a given engine. Effect of humidity is far greater with highly leaded fuels than for those with little or no lead but having the same octane number. Thus engine performance on a highly leaded fuel may be freer from detonation troubles during high atmospheric humidity and yet be poorer when the air is relatively dry. Hence the effect of humidity should be considered in specifications or when making service tests.

Now for the interesting problem of "safety fuel", which is a fuel that will burn with normal efficiency within the engine and yet be free from the hazards of uncontrolled combustion outside the engine. Anthracite coal might be the safest fuel if a suitable engine could be devised. Safety fuel generally means a liquid hydrocarbon fuel with a flash point of approximately 105 deg. F. which boils between about 325 deg. F. and 400 deg. F. To obtain high knock rating, fuels previously used experimentally were of the aromatic type but recent developments have produced high octane fuels of the saturated type. Lead may be used to improve to some degree the knock rating of safety fuel.

Advantages and disadvantages of gasoline with conventional carburetors are well known, but the use of gasoline with injection equipment is still new and much remains to be learned of its operating characteristics. Since the outstanding characteristic of safety fuel is its resistance to vaporization, it cannot be used in regular carburetors without employing prohibitive mixture temperatures. The alternative is to use direct cylinder injection which involves equipment not yet commercially developed.

The author believes that many persons who look upon safety fuel as a panacea have not considered all the facts. In the future both gasoline and safety fuels will have their distinct fields in aviation. The use of gasoline can be made safer, but safety fuels will also give satisfactory engine performance that will add to flying safety when necessary developments have been completed.

Safety fuels are being experimented with today in the hope that their development will lessen fire hazards. The sources of ignition of fuel outside the engine include contact with hot surfaces, stray sparks, open flames and static.

Following a forced landing a fire may occur because lubricating oil comes in contact with hot engine parts, and the oil fire may start a gasoline fire. In such instances the use of safety fuel would not prevent a fire although the fire might spread slower and add to chances of passengers' safety. Crashes on water, however, may result in the hot engine being immediately cooled by the water. Con-

(*Turn to page 101*)

CERTIFICATE No.
1
UNITED STATES OF AMERICA
CIVIL AERONAUTICS AUTHORITY
WASHINGTON, D. C.
Air Agency Certificate
This is to Certify, That PARKS AIR COLLEGE, INCORPORATED
Located at PARKS AIRPORT, EAST ST. LOUIS, ILLINOIS
Is rated as AN ADVANCED FLYING SCHOOL
By direction of the Civil Aeronautics Authority:
Issued JULY 17, 1939.

PARKS Receives C.A.A. Certificate No. 1 as an ADVANCED FLYING SCHOOL

Let Parks Recognized Leadership Training Prepare You for Success in Aviation!

Here's additional proof of the widespread recognition accorded the high standards of training maintained at Parks Air College. The new Air Agency Certificate No. 1, rating Parks as an Advanced Flying School, has just been issued to the College by the Civil Aeronautics Authority.

But Parks has long been a fully approved school; in fact, has enjoyed the approval of the Federal Government as an Advanced Flight School *longer than any other aviation school in the country*. On July 15, 1929, Parks was granted a certificate of approval, issued by the Department of Commerce, as a Transport, Limited Commercial, Private, Ground and Flight School.

Parks Additional Recognition

includes the following: listed in "Accredited Higher Institutions 1938," issued by the Office of Education, U. S. Interior Department; the Aeronautical Engineering School is recognized and approved by the Superintendent of Public Instruction of the State of Illinois; the College is registered by the Illinois Department of Registration and Education.

Parks Air College is approved by both the U. S. Army Air Corps and the U. S. Navy and is cooperating with the Air Corps in giving flight training to flying cadets and aviation mechanics training to enlisted men. Parks graduates fulfill educational requirements for appointment as Flying Cadets in the U. S. Army Air Corps or for appointment to the U. S. Naval Aviation Reserve for flight training.

Even though the C. A. A. standards for approval are now higher than ever before, the scope of the various courses offered at Parks considerably exceeds in content that required for such approval.

You who are desirous of making commercial aviation your career, should carefully consider the recognition and standing of your school. Parks extensive recognition is the result of Parks serious purpose as an educational institution—to train men for leadership and responsibility in the industry. Parks offers three courses, each of two years duration: Professional Flight and Executive, Aviation Operations and Executive, Maintenance Engineering, and Aeronautical Engineering requiring 2¼ years. The coupon will bring you 64-page Parks Bulletin and full information. It's sent free and without obligation. Write for it today.

Parks Air College
East St. Louis, Illinois. Section AV 4

Please send me details of Parks four major courses in commercial aviation training.

Name.....Age.....

Address.....

City.....

State.....

PARKS AIR COLLEGE East St. Louis, Illinois

Now . . . Stainless Manifolds for *NEW TORPEDO BOMBERS*

Hot exhaust gases "tamed" by stainless construction

ALWAYS alert to any technological advancement that will improve its aircraft, the U. S. Navy recently placed in service this squadron of torpedo bombers, all equipped with stainless engine exhaust manifolds.

Stainless was the natural choice for these ships' engine exhaust manifold systems, since it possesses all the properties necessary for safe handling and disposal of the hot, corrosive exhaust gases.

At prolonged operating temperatures from 1000 to 1600°F., it has high ultimate strength.
It stubbornly resists corrosion resulting from exposure to atmosphere and to products of modern "doped" fuels.
It minimizes oxidation scale through the entire temperature range.
It effectively resists surface abrasion at points of metal-to-metal contact.
It offers excellent fabrication qualities, such as deep drawing, bending and welding.

These are the principal reasons why leading aeronautical engineers have adopted U·S·S Stainless Steel as the standard material for exhaust manifolds and collector rings. This construction, using the stabilized material which is not subject to intergranular corrosion, has proved itself in actual service records of 7000 and more hours. Today, it is serving successfully as standard equipment on most of America's famous airplanes, both in civil transport and in Army and Navy fighting craft. Write today for engineering details.

SQUADRON OF Douglas Torpedo Bombers in formation flight. These new ships all include stainless steel exhaust manifolds, built up from half sections deep-drawn to shape in a drop hammer and assembled by welding. Official photograph U. S. Navy.

USS **STAINLESS STEEL**

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
NATIONAL TUBE COMPANY, *Pittsburgh*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York · Scully Steel Products Company, Chicago, *Warehouse Distributors*

UNITED STATES STEEL

(*Continued from page 98*)

sequently there is an advantage in using safety fuel for over-water flights.

The second source of fire, stray sparks, may occur in a variety of places in an airplane. They may result from a momentary interruption of a circuit carrying current, or from a flash-over in a circuit of high potential. Safety fuel would provide almost complete protection from these sources of trouble except in confined spaces at elevated temperatures. However, regardless of the fuel used, added safety could be achieved by design changes in the present fuel plumbing system. Fuel lines that run from the tanks to the cockpit and then back to the engines by way of numerous valves and fittings offer many chances of undetected leaks and consequent ignition hazards. Remote controls are now reliable and their use with the shortest possible connecting lines would reduce fires from stray sparks almost to the vanishing point.

Fuel fires from exhaust flames may start from emergency dumping of fuel or from a major fuel leak. Aside from these possibilities, the only other apparent source of ignition from open flames is the smoker, who lights his cigarette when a combustible mixture is present in the cabin. Safety fuel would prevent such an accident except in the extremely rare case of a leaky fuel system in a ship that had been standing for some time in the direct sun on a very hot day. Removal of the plumbing system from the inner wing sections and cabin would minimize such fires as it also would from stray sparks.

Static as a source of fire is an intangible thing. Fires are frequently attributed to this cause and yet it is extremely difficult to reproduce laboratory conditions accurately enough to study the problem. If fires are started by static, safety fuels may be the most dangerous of fuels. The vapor space of a gasoline tank is always filled with a mixture too rich in fuel to ignite. On the other hand, the vapor space of a safety fuel tank will frequently be in the explosive range during hot weather so that should ignition occur due to static—or for any other reason—the structure of the tank and the ship would be subject to destruction. A point that may be held against a safety fuel is the danger of static generation due to sloshing of the fuel in the tank or at the time of an emergency fuel dump.

Data on safety fuel under the assumed conditions are not available, but experience with other hydrocarbons similar in nature has shown them to be subject to the development of static charges higher than obtainable with gasoline. This is particularly true when slight traces of moisture are present, a condition not uncommon in the fuel tanks of transport airplanes. The most apparent remedy for this condition involves the maintenance of an inert atmosphere in the vapor space of the fuel tanks. A suitable supply of such gas is available in the engine exhaust system but it will be necessary to wash and dry it, and fit the tanks with suitable valves. However, for ships operating under conditions where the temperature of the fuel never approaches its flash point, no such precautions are necessary and safety from such hazards is assured.

It may be argued that safety fuel could be made more safe by simply further decreasing its volatility, but such a move multiplies many times the difficulties of efficiently burning the fuel in the engine.

The use of safety fuels presupposes the availability of suitable fuel injection equipment. It would seem that before learning to walk it would be well to learn to creep. Would it not be wise to first perfect the gasoline injection engine? Improved gasoline operation would undoubtedly result and the experience gained would go far toward indicating the solution to the more perplexing problem of safety fuel injection.

To summarize: Facts regarding fuel characteristics should be reviewed in the same way that structural materials and manufacturing techniques are considered. Both consumer and supplier will benefit from fuel specifications that are no more restrictive than required to insure safe, efficient and trouble-free operation. It is to the consumers' interest to support the unification of fuel specifications. While engines can be changed rapidly, changes in fuel types involve years of research and millions of dollars for plant construction and distribution facilities, a cost reflected in the price of the fuel. When changes appear desirable, take the fuel refiners into your confidence. Regardless of the apparent virtues of regular gasoline or safety fuel, carefully consider all advantages and disadvantages before making any radical moves. Carefully consider also the possibilities of reducing hazards by any mechanical means that would be available.

5 WAYS TO CUT DRAFTING TIME and EXPENSE

● Here's how OZALID TRANSPARENT papers, cloths, and foils provide short cuts in drafting practice and reduce costs.

1. DUPLICATE ORIGINALS ON TRANSPARENT PAPER, CLOTH OR FOIL FOR BRANCHES OR CUSTOMERS . . . made in the same simple manner as standard Ozalid Whiteprints.
2. TRANSPARENT DUPLICATES WITH CHANGES FOR SPECIAL PURPOSES WITHOUT ALTERING ORIGINAL DRAWING . . . produced by deleting detail and making additions on the duplicate. Standard Ozalid Whiteprints incorporating these changes are made from these transparent duplicates.
3. OLD, SOILED OR WORN TRACINGS . . . reclaimed and weak pencil lines intensified with Ozalid foil which can be cleaned to eliminate spots, blotches and crease marks.
4. COMPOSITE PRINTS . . . accomplished by bringing the details of as many as six originals together into one Ozalid Whiteprint by the use of Ozalid foil.
5. WHITEPRINTS . . . made from inexpensive Ozalid transparent duplicates, while valuable originals are stored safe from fire, wear, and tear.

ONLY OZALID HAS DRY DEVELOPMENT

Ozalid CORPORATION
ANSCO ROAD · JOHNSON CITY, N. Y.

OZALID CORP. 10-4
Ansco Road, Johnson City, N. Y.
Please send full information on how Ozalid transparent materials cut drafting costs, and free booklet of dry-developed Ozalid prints.
Name_____
Company_____
Street_____
City_____ State_____

Winged Victory

(*Continued from page 33*)

estimates and they are not always consistent in their reasoning. So, one object of this article is to arrive at probable present air strengths, accomplished by building up through the past several years from rates of production on which quite accurate information is available. The figures obtained have been checked against the most logical of the current estimates and modified where such considerations have warranted it. The curves here shown are the result.

Rate of production

A fairly good conception of rate of production of airplanes of the countries at war in Europe was obtained by the writer during extensive visits to airplane and engine factories in England in 1934, 1936, 1937 and 1938; in France during 1934, 1936 and 1938; and in Germany during 1936. Numerous discussions with others in the industry who have traveled abroad have added further information.

Of course, censorship has for some time prohibited the printing of direct information on actual rates of production. Frequently, however, information on floor space, labor force, appropriations, and other such data has appeared and has made possible the working out of production rate figures by the use of constants developed on the basis of known actual practice in this country. This was the method used in the June 1939 AVIATION article and it is desirable here to recapitulate some of these constants and the assumptions on which they are based, re-checked in the light of the experience of the past nine months. These data appear in Table 1.

TABLE I

MISCELLANEOUS CONSTANTS FOR COMPUTING AIRCRAFT PRODUCTION VALUES AND QUANTITIES

Item	Unit	Airplane Structure	Engine & Propeller
Concentration	Square Feet per Man	100	204
Money Value	Dollars per Sq. Ft. per Year	56	49
Money Value	Dollars per Man per Year	5,600	10,000
Money Value (Approx. Average)	Dollars per Pound	7.5	7.5
Weight Value	Pounds per Sq. Ft. per Year	7.5	6.5
Weight Value	Pounds per Man per Year	750	1,340

Assumptions

It is assumed—

1—that capacity conditions, which are approximately two full day shifts, maintain. (This actually equals about one full day shift plus three-fifths day shift on first night shift and two-fifths on second.)

2—that all-metal type of airplane structure is used.

3—that average size of airplane orders are lots of 400; and that engine and propeller factories are operating near capacity.

4—that a profit margin of 10% is realized.

5—that labor average rates are:
airplane factory.....$.70/hr.
engine factory.....$.80/hr.

6—that airplane structure weight is equal to gross weight less useful load and less weight of engine, propeller and instruments.

7—that floor space includes stockroom but excludes office space.

As a sample of the method used, the following three examples are given. It is obvious that this method can be extended so as to shed light on the basic problem as each new piece of factual information comes to hand.

"Examples" illustrating method

"A"—How near is the American Aircraft Industry to its capacity?

Airplanes

With about 8,250,000 sq. ft. of floor space and 60,000 workmen, we have 137.5 sq. ft. per man and therefore are 73% capacity, which is estimated to be 100 sq. ft. per man.

Engines and propellers

With about 3,500,000 sq. ft. of floor space and 16,000 workmen, we have 218 sq. ft. per man and therefore are 94% capacity, which is estimated to be 204 sq. ft. per man.

"B"—What should be our yearly dollar value of production? (using present labor force and facilities, and several of the "constants" of Table 1).

Airplane

$5600/man/yr x 60,000 workmen = $336,000,000 or, using another basis as a check, $56/sq. ft. x 8,250,000 sq. ft. x 73% Cacapity = $336,000,000.

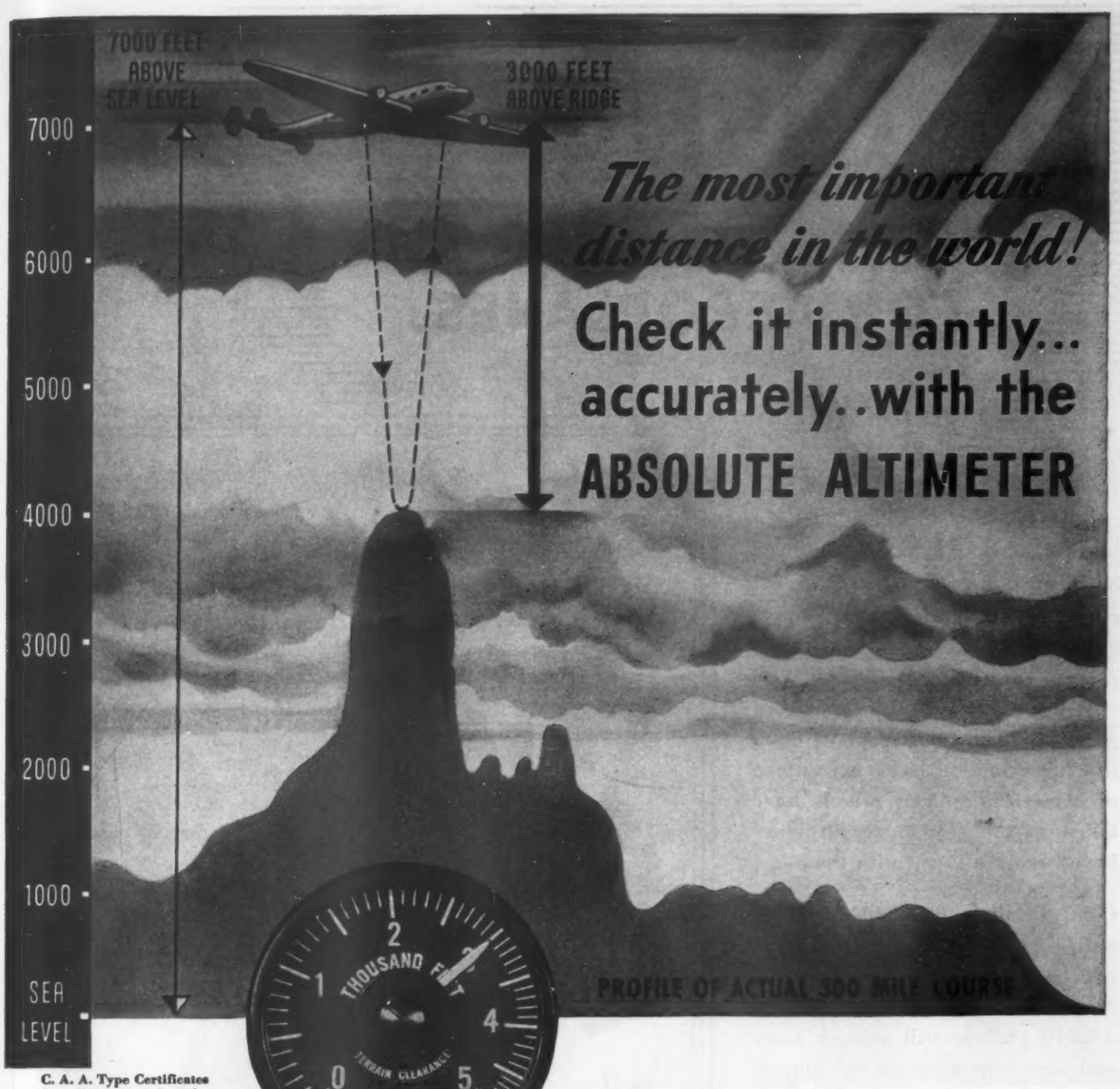
Engines

$10,000/man/yr x 16,000 workmen = $160,000,000 or, using another basis as a check, $49/sq. ft. x 3,500,000 sq. ft. x 94% Capacity = $161,000,000. Total = $496,000,000, which checks with several current estimates.

(*Turn to page 106*)

European

Heinkel H E 112 Pursuit Planes



C. A. A. Type Certificates have been granted on the 1B Radio Altimeter apparatus elements.

Transmitter sends out radio wave which is reflected back from earth to receiver. Elapsed time for "round trip" is converted into absolute altitude - instantly shown on meter above.

With the Western Electric Absolute Altimeter, altitude becomes height above *ground* — the *vital distance* between your plane and the terrain beneath.

Day and night, clear and cloudy, the Radio Altimeter gives you continuous, instantaneous, accurate readings of your terrain clearance. It's not affected by atmospheric pressure, temperature, humidity, cloud layers or static.

The aviation world has hailed this new development of Bell Telephone Laboratories and Western Electric as the greatest contribution to flying in years! Get full details from Western Electric Co., Dept. 9640 A, Kearny, N. J.

Western Electric

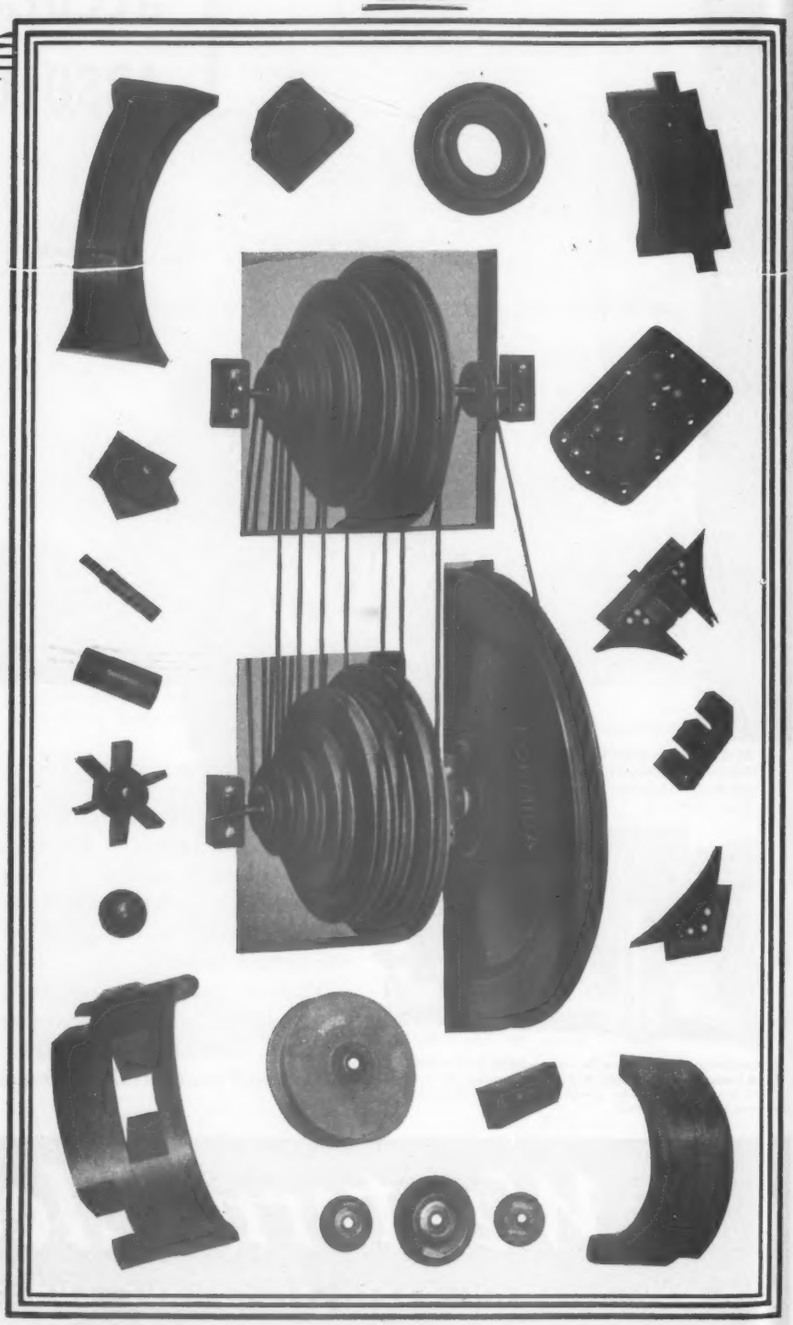
Northern Electric in Canada

TWO-WAY AVIATION RADIO TELEPHONE AND TELEGRAPH EQUIPMENT

FORMICA

PULLEYS • FAIRLEAD BUSHINGS • AND MACHINED PARTS

FOR AEROPLANES.



Lightness and stability of dimensions under varied conditions of humidity and temperature have made Formica pulleys for the control of aeroplanes, fair lead bushings and other machined parts popular with aeroplane manufacturers and a large percentage of American planes which have taken to the sky in recent years have been equipped with them.

Control pulleys are molded individually from type II phenolic material complying with United States Army and Navy specifications. All AN 210 pulleys will exceed army and navy requirements for run-out tolerances, static load, bonding, flange shear and resistance to fatigue.

Send your inquiries for standard pulleys, or your blueprints for quotations on machined parts.

The Formica Insulation Co.

4618 Spring Grove Avenue
Cincinnati, O.

FORMICA

"Congratulations, my boy. You've a future in aviation."

For the moment he's the happiest boy in the world. He's won a prize in a model airplane meet. But it isn't the prize that really counts... it's the thrill of building a better plane than anybody else.

Isn't it really this same thrill that keeps practical aviation men striving to surpass today's performance? Building planes that fly farther, faster, and with heavier loads? Searching for more *power?*

For the development of aviation is closely linked with power. That's why the engineers of the Ethyl Gasoline Corporation are today working with aviation technicians in the improvement of fuels and engines.

A program of continuous research has already developed a mass of useful data. Some of this information can be applied to today's problems. Much of it will be of greatest value in years to come—the years when youngsters like our prize-winner above are ready to seek their "future in aviation." IT PAYS TO FLY

ETHYL GASOLINE CORPORATION, manufacturer of anti-knock fluids used by oil companies to improve gasoline

(*Continued from page 102*)

"C"—What is the Current Production Rate of Airplanes in Germany?

When averaging several sources one obtains a figure of 400,000 men in the German aircraft industry, including the main companies with the smaller sub-contracting units which feed parts into them, and including airplane, engines, propellers and instruments. In our industry we have for these items about 85,000 men (assuming 9,000 for instruments) which would total 100,000 after adding for sub-contracting outside the principal companies of the industry. We might then expect Germany's production rate to be 400,000 ÷ 100,000 = 4 times our own. But her production lots average greater than ours, perhaps twice as many (800 vs. 400) making possible a greater output per man. Using .90 for this factor we obtain 4 ÷ 90 = 4.44 times our output which appears to approximate the facts.

Analyses of this kind are admittedly approximations but when figures obtained by many different methods of approach are checked and re-checked, and when a fair degree of judgment is exercised, final answers near the truth should result. One source of error which may occur through using this method of applying "constants" is failure to be on guard against violation of assumptions on which the "constants" of Table 1 are based. For example, assumption 3 pre-supposes production lots of 400 as an average; there are many factors involved in determining rate and cost of production as size of order changes, such as degree of tooling, number of changes from a model previously manufactured, extent of previous manufacture of similar models and general morale efficiency of the workers. As a rough average for analyses of this kind, it has been found reasonable to assume a factor of .90, as used in example "C" above, to take care of a quantity other than 400 in a given lot. This factor means that every time the quantity in production is doubled, the unit cost will be only 90 per cent as great as in the smaller lot.

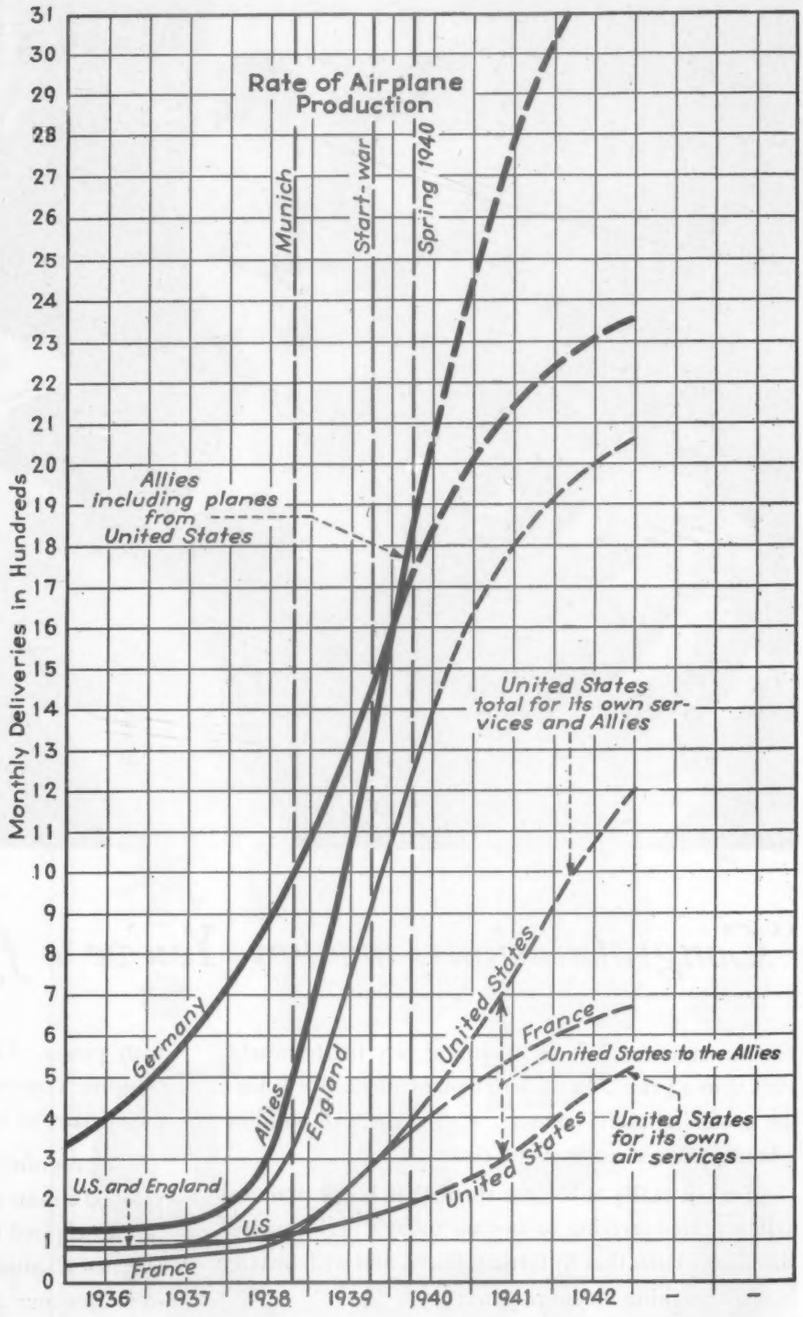
There are many things to consider when estimating the rate of delivery which it may be anticipated the factories of this country can make to the Allies. For instance, great care must be taken when making a check of quantity using the money value of orders as basic data, since information frequently is not available on the additional price paid in order to take care of accelerated deliveries, which involves payments for plant expansion necessary to step up production. Also, profits may differ from those of the basic assumption.

However, sufficient information is available to permit making a good estimate of export deliveries, based on current orders and on expansion of facilities now under way. Deliveries of planes and engines on present orders extend into 1941. Further acceleration of delivery of these or of new orders will require extensive added expansion of their facilities.

The curves

After due consideration of the information from the many sources previously mentioned, and the need for caution in interpreting such data, the curves of Figure 1 have been produced to show the monthly deliveries that have maintained since January

(*Turn to page 109*)



Allies Have Already Passed Germany in Monthly Production of Airplanes, Including Deliveries Being Received from U. S.

HEADING *for New Conquests*

Progress in aviation, as typified by Vultee's Vanguard pursuit ship, is a never ending conquest of new barriers of time and space. Yesterday's limits of speed and flight range serve only to mark the progress made today.

Much the same attention to improving yesterday's methods that has been the basis for Vultee's steady progress in aviation marks the alertness of our own organization in the search for ever improved methods of producing "Ohio Special Quality" tubing. We are proud to have had a part in furnishing the aviation industry with material that has made possible many of today's finest ships.

The OHIO SEAMLESS TUBE CO.
OHIO SPECIAL QUALITY
Shelby, OHIO

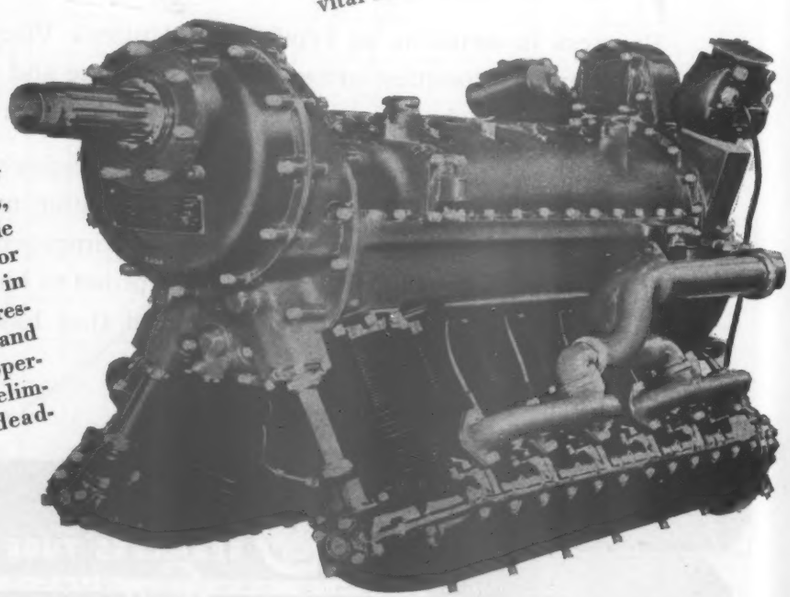
CHROME MOLYBDENUM FOR STRENGTH LIGHTNESS AND SAFETY

Small shaft performs TOUGH TASK!

Depending upon the resiliency of tough medium carbon Nickel-chromium alloy steel, this small quill shaft cushions the power strokes and inertia forces of the 500 HP Ranger aircraft engine shown below. This 1.671" diameter shaft, hollowed to a wall thickness of 0.226", transmits crankshaft torque directly to the reduction gear pinion. To withstand fatigue stresses and shock loads, Nickel-chromium steel, heat treated, is specified. Nickel alloy steels respond readily to heat treatments which develop high strength/weight ratios so vital in modern aircraft design.

NICKEL ALLOY STEELS

Lower weight per HP is a feature of this 500 HP in-line, air-cooled 12-cylinder power plant developed by the Ranger Engineering Corp., Farmingdale, L. I. This lighter weight is attained partly by the use of Nickel alloy steels for stressed parts such as gears, shafts, etc. Strong, tough and reliable materials must be used throughout, for there are no "unimportant" parts in an airplane engine. Nickel is also present in the "Y-alloy" cylinder heads and pistons. The good mechanical properties of the Nickel alloys permit elimination of needless bulk and deadweight. Your consultation is invited regarding applications of Nickel alloyed materials.



THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

Announcing

LIBERTY AIRCRAFT PRODUCTS CORPORATION

(formerly KIRKHAM ENGINEERING & MFG. COMPANY)

WITH experienced personnel and enlarged facilities geared to the Industry's present pace and future needs, LIBERTY AIRCRAFT PRODUCTS CORPORATION will carry forward a fine tradition of high speed production of precision parts to Government Specifications.

Now serving many leading aircraft, engine and accessory manufacturers, our Design, Engineering and Manufacturing organization is in a position to save you money and time on parts production. There are scores of modern high-output precision machine tools and miscellaneous equipment in our machine shop . . . a wing division equipped to make all types of sheet metal parts including pontoons . . . large stocks of Government inspected material. We offer you the most modern heat treating units, anodyzing and cadmium plating equipment. Let us be your parts department . . . inquiries invited.

. . . *formerly* KIRKHAM ENGINEERING & MFG. COMPANY—*now*

LIBERTY AIRCRAFT PRODUCTS CORPORATION

FARMINGDALE, N. Y., U. S. A.

Going Places In 1940? . . . Then Let This FREE MANUAL Help You

You will find that this Manual explains pilotage and flight technique from the ground up. It has been specially compiled by the editors of AVIATION to meet the needs of Students, Pilots, Mechanics, Plane Owners, Fixed Base Operators, Transport and Airport Men. It is yours, without cost, with your subscription to AVIATION—the monthly issues of which bring you equally practical ideas for making your way in your chosen work.

Just a squint at the authors names and subjects will tell you that here's a book *you've got to have.* Lt. Commander P V. H. Weems tells you how to find your way in the air—Dead Reckoning, Compasses, Celestial Navigation, etc. John P. Gaty tells you all about the radio compass and how to apply it to navigation. E. A. Cuttrell explains instrument flight and radio beam flying. And he tells you of the faults and difficulties usually encountered and how to overcome them. He tells you how to land a plane when the ceiling is down on the carpet. Don Fink tells you all about radio equipment and how to use it. You'll get great articles by Del Vecchio and Sayre on the fundamentals of air mass soundings. D. W. Tomlinson gives you all the dope on high altitude flying. Edmund T. Allen gives you the low-down on flight testing. D. J. Brimm, Jr. tells you all you have to know about water flying technique. Tex Rankin tells you all about precision acrobatics. There are many others, too.

This book will help you realize your flying ambitions. The *Questions and Answers* of typical Civil Aeronautics Authority examinations alone will save you hours of work and study.

This book that has set the whole industry talking is FREE to every new reader to Aviation.

Attention: Present Subscribers

You may obtain a copy of this FREE book by renewing your present subscription. *Regardless of when your present subscription expires,* you must send in another PRE-PAID renewal order. Your subscription will be extended for additional time without duplication. Mail in your order and payment today.

Forward March In Your Flying Career—with AVIATION and this 200 page, practical manual

MAIL THIS COUPON AT ONCE

AVIATION, 330 W. 42nd St., New York, N. Y.

I enclose $4. Enter my subscription to Aviation for two years and send me the "Pilot's Manual" FREE!

( ) If renewal order, please check here.

( ) For 1 year subscription enclose $3 and check here.

Name .....

Address .....

City .....***State*** .....

Company .....

Position 4-40

This Offer Good Only in United States, Possessions and Canada.

If you're just starting out—if you're experienced but feel you're in a groove—if you're impatient to get ahead faster—this book and the monthly issues of AVIATION can help you with these aims. Thousands of our readers who started with us as students are now important men in the world of flying. They claim that the all round coverage and information brought them by AVIATION has helped them to advance. This same material can help you. And the cream of much of it is contained in the pages of "Pilots Manual" which comes to you free.

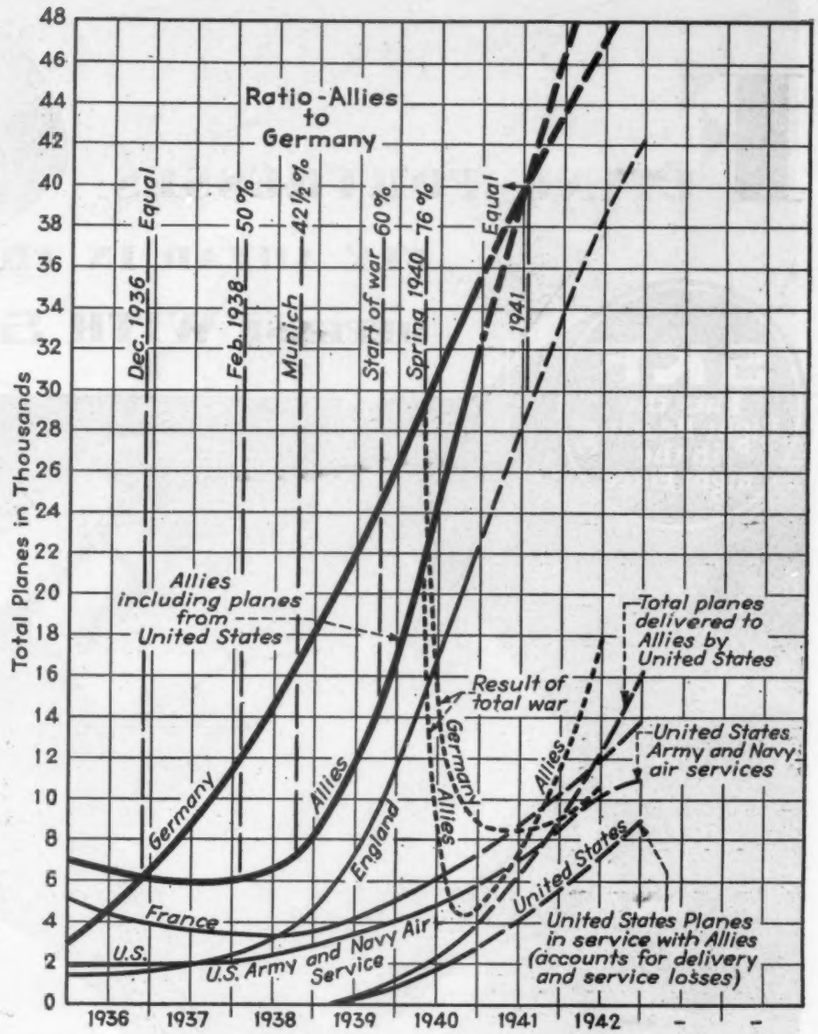
To get your free copy of the "Pilot's Manual" simply use the handy form below. Every paid-in-advance new or renewal subscriber may have a copy of this helpful book, without cost. Send only the regular subscription fee—$3, one year, $4 two years—and your book will come to you at once. There may be just the information you need in the pages of this book. Let it, and the monthly issues of AVIATION help you go places in flying. Get your copy at once by filling out the convenient form and mailing it to us NOW.

(*Continued from page 106*)

1936, and projected from the present time through 1942. The rather constant increase in rate of production of Germany since 1936 with her substantial lead over the Allies at that time, is noteworthy. The slow start which the Allies and the U. S. made and the relatively small production extending well into 1938, coupled with rapid increase of rate of production in England subsequent to 1938 are also important. Here I would like to emphasize the magnificent comeback that England has made in the air after a very slow and muddling start. One should also note the rapid increase in assistance to the Allies from the United States which may be expected to maintain from now on, even while building up the rate of delivery under our production program as required to meet our own Air Force expansion needs. But, compared to England and Germany, our production is still small. It becomes larger as time goes on and will become of extreme if not deciding importance eventually, morally as well as materially.

Growth of air force

The method used to obtain the curves shown in Figure 2 is the following: A start is made in January 1936 with an estimated air strength for each country. Information was not withheld at that time as it is now so that the relative strength and, to a somewhat lesser degree of accuracy, the actual strength could be determined. Then, the strength for each succeeding year is estimated by increasing for that year, each country's air force by the amount obtained by integrating the curves of Figure 1 and then reducing by an amount estimated to take care of obsolescence and wastage due to crashes or other causes of loss. It has been found that in this country, the yearly depreciation of the air force is approximately 22 per cent in normal times, probably somewhat less during a period of rapid expansion. In determining depletion for European countries during the period 1936 to date, varying rates of depreciation were used, depending on particular circumstances which were found to maintain as regards rate of obsoleting equipment, rate of training and probable resultant crashes, both in training and service. The figures average from about 25 per cent per year in 1936 to 45 per cent per year by January 1940. This, it should be noted, is a monthly rate of depreciation of from two per cent to about four per cent. At the present time, March 1940, with relatively minor air activity, it is not believed that the depletion is more than five per cent per month, judging from the published losses of the various belligerents, coupled with the other factors cited above.



In Total Planes Ready for Service, Allies will Not Overtake Germany until Early 1941

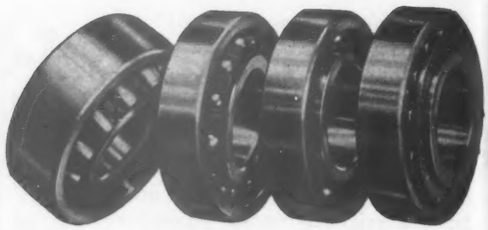
It should be noted that the curves of Figure 2 cover total planes of all types, including first-line, reserve, cooperation, and training. In using the method herein described for obtaining air power, total labor force or square feet of floor space are important factors.

It is therefore necessary to plot total air force strength including all types of planes, as stated above. However, as shown on Figure 2, the proportion each class of plane bears to the total approximates the percentages shown, with admitted variations from these amounts, depending on the special emphasis which a given country may currently place on building up its various branches: first-line, reserve, cooperation types (reconnaissance, observation, and cargo), or training. For example, Germany, an aggressor, emphasized bombers; England, a defender, pursuits. During certain periods of expansion, trainers must be emphasized. Also, the proportions of first-line to reserve are affected by availability of pilots. It is believed, however, that the percentages given will not vary for any country by more than 15 per cent of the values shown.

The curves for total air power have been extended beyond the present time, showing a tendency to flatten out, based on similar falling off in increase in monthly delivery rates

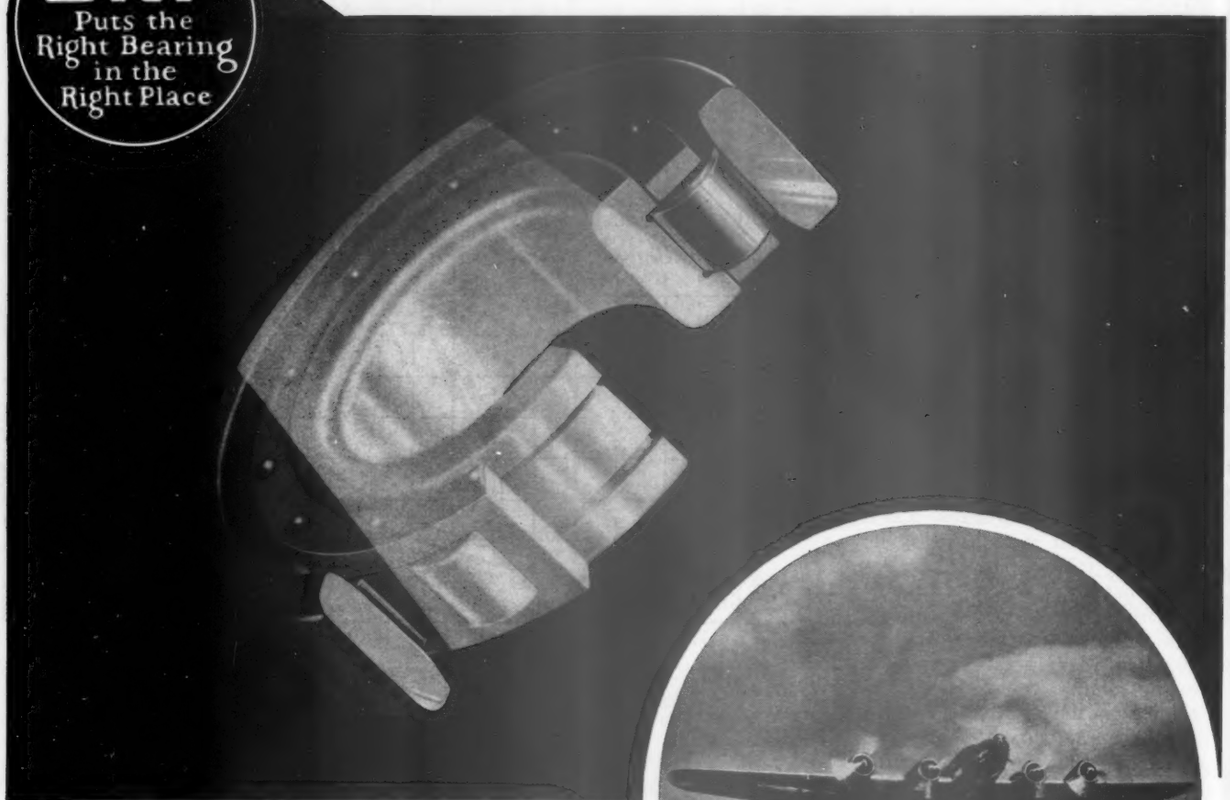
(*Turn to page 112*)

FLYING FORTRESSES



FLY AHEAD IN THE FIRST LINE OF DEFENSE WITH SKF BEARINGS

SKF Puts the Right Bearing in the Right Place



One of a fleet of Flying Fortresses, built by Boeing Aircraft Co. and powered by four SKF-equipped 1000 h. p. engines manufactured by The Wright Aeronautical Corporation.

THE FIRST LINE OF DEFENSE takes to the air on SKF's as wings of the mighty Flying Fortress soar protectively over America. With a wing span of 105 feet, a length of 70 feet, and powered by *four 1000 h.p. Wright "G" Cyclone Engines,* it ranks as one of the world's fastest heavy bombers.

That it is SKF-equipped for dependable bearing performance is a tribute to the engineers who designed it . . . a warranty of safety to the men who fly it. For SKF Bearings are built to stand up under the tremendous surge of power from Cyclone engines . . . to run smoothly at all altitudes in all kinds of weather. When a bearing flies, *performance* with minimum weight is the only thing that counts.

4486

SKF INDUSTRIES, INC., PHILADELPHIA, PA.

SKF

BALL & ROLLER BEARINGS

Continental Powered Planes Finished First, Second, Third, and Fourth . . . Firestone Trophy Race

The first was Jack Snodgrass. Then came Ellis Eno. Third place went to Guy A. Ham, and Robert R. Maynard finished fourth. That's how they finished the Firestone Trophy event during the Miami All-American air maneuvers. It was a 100% Continental victory with the winner averaging 105.255 M. P. H.

Only **CONTINENTAL offers Mechanical FUEL INJECTION**

This positive mechanical distribution of fuel is now available on the Famous "A" series 4-cylinder aircraft engines. More power—less fuel—smooth, dependable performance in every maneuvering position. No failure due to water in gasoline or carburetor icing.

Continental's Famous "A" Series Red Seal Aircraft Engines

These famous Red Seal engines are standard or optional equipment on Aeronca, Luscombe, Piper Cub, Porterfield, Stinson, Taylorcraft, Welsh — and dominate the 40- to 80-horsepower field. Equipped with carburetor or mechanical fuel injection — an exclusive Continental feature.

Showing front view of A-65 with carburetor.

Continental Motors Corporation
Aircraft Engine Division
MUSKEGON, MICHIGAN

(*Continued from page 109*)

as the estimated capacity of the country involved is approached. Such capacity may be limited by personnel, by machine tool equipment, by raw materials supply, or for other reasons.

Effect of "total" war

Shown in dotted lines on Figure 2 are the effects on the total air power strength of the Allies and Germany which will maintain in the event of a "total" war in the air taking place. These curves have been derived by assuming continuing rate of production as given in Figure 1, (as it is impossible to guess even the approximate falling off of production that might result from bombed aircraft factories), but assuming destruction of planes in service at the rate of 25 per cent of total strength per month. This 25 per cent rate of depletion, it should be noted, is at the low limit of plane casualties frequently forecast as probable in the event of real air warfare, as such estimates have ranged from 30 per cent, put forward by several English authorities, through 50, or even 80 per cent mentioned by certain German and Italian writers. I am inclined to doubt that anything like these last mentioned will maintain, particularly when considering the effect on air strength which results. Furthermore, even in the event of a "total" war, there may be reluctance on the part of Germany to dig too deeply into her oil, iron and aluminum reserves. Twenty-five per cent of Germany's air force was used in estimating the reduction in strength of the Allies as well as of Germany. This is the most pessimistic point of view (from the Allies' standpoint) as, if Germany is the aggressor, she will probably lose far more planes than the defending Allies. When using 25 per cent, as stated, an interesting point which these curves portray (assuming that the "total" war starts this Spring) is that the air strength of the Allies will exceed that of Germany during the last half of 1941, although towards the end of 1940, there will be a dangerous disparity between the two air forces in favor of Germany. Strangely enough, in the event a "total" war does not start this Spring, the relative strengths of the belligerents in the air will become equal only a couple of months earlier in 1941!

Quality

Comment on this admittedly important subject will be restricted to the statement that in the writer's belief, quality of equipment is and will remain substantially equal. As the war proceeds, one belligerent or the other may, for a time, excel in some particular branch as, for example, it is believed the Allies now excel in pursuit aviation and Germany in bombardment (even this latter point might be questioned, particularly if proper credit is given to the highly developed and effective power controlled, rear-firing gun turrets with which many British bombing planes are equipped). It is not believed, however, that superiority in performance of equipment will so predominate on either side as to make this the determining factor. No one who has inspected German equipment and German research laboratories, and is aware of German general engineering and scientific ability, can believe the quality of her products from the performance standpoint, is likely to be greatly exceeded. There is the possibility that German quality may suffer as the war goes on, due to the necessity of using inferior materials caused by curtailment of supply, although probably not for some time to come. Similarly, one cannot feel that the Allies will trail in quality after viewing such notable English aircraft equipment as the "Spitfire" and the "Hurricane" or knowing of the more recent developments in France, or of the excellent service experience in the hands of the French rendered by planes delivered from the United States.

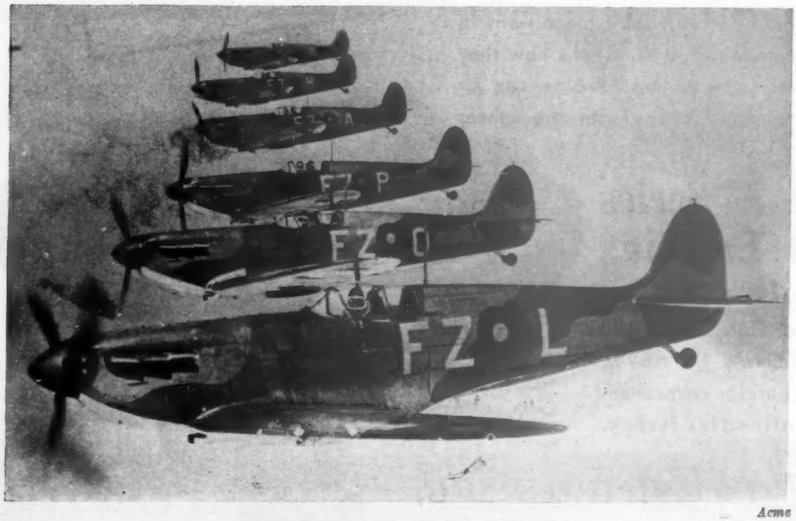
Analysis

If we may assume then, that the curves presented are essentially correct, or at least within reason, it is now timely to analyze their meaning. Referring to Figure 2, we see that equality of air strength maintained in December 1936 may be expected again to maintain in the second half of 1941. Between 1937 and the start of the war, there has been a substantial and important disparity in favor of Germany. In February 1938, the present Allies had but 50 per cent of the air strength of Germany; by September 1938, the greatest difference of the whole period existed, Germany having about a two and one-half to one superiority—and this was the exact time of Munich! I feel certain that this superiority is the true explanation of Munich.

Military history has indicated that it takes time for each new offensive weapon to bring out an antidote of defense and the past four years have shown the manner in which unscrupulous nations can make use of any supremacy which they may temporarily gain. Such superiority in the air on the part of Germany has brought about the Austrian anschluss, Munich and the rape of Poland. Italy demonstrated it earlier in Ethiopia, then Japan in China and now Russia in Finland. But in World War II in Europe, defense is now catching up, partly through improved anti-aircraft, but more particularly because of approaching parity in the air itself.

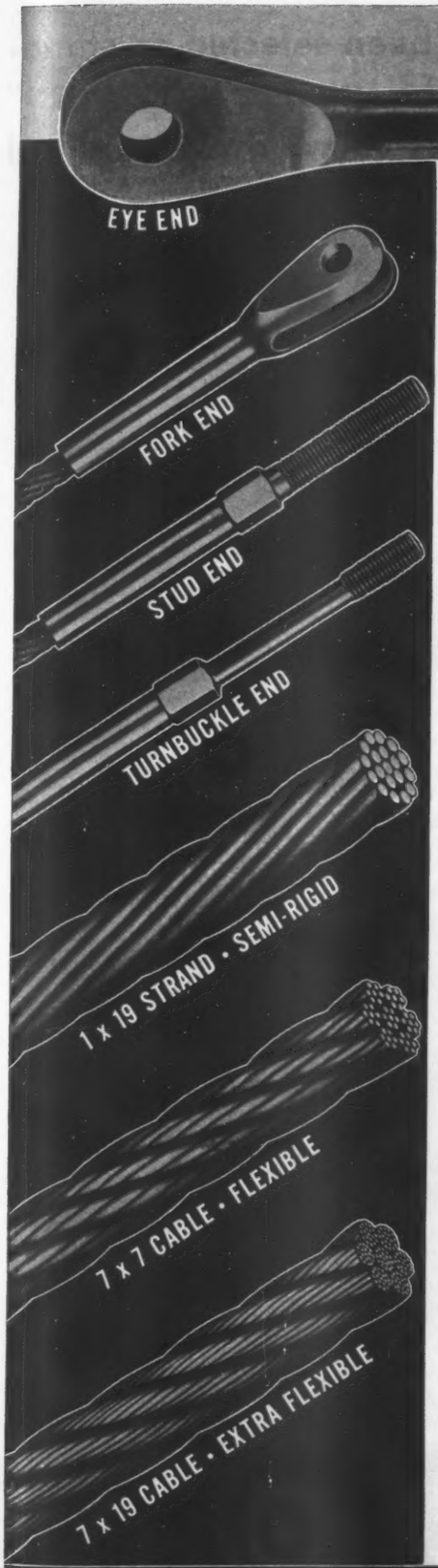
By the start of the war, the Allies had improved production so much that their combined air force was 60 per cent of that of Germany and the time had passed when it could be anticipated that an aerial Blitzkrieg on the part of Germany would be successful. A superiority of two to one might

(*Turn to page 115*)



Acme

British Supermarine Spitfire Fighters



AMERICAN CABLE

"KORōDLESS"

(STAINLESS STEEL)

Aircraft Controls

● Army and Navy specifications are exceeded by American Cable's "KORōDLESS" controls. They will not corrode under any conditions so far encountered in flying. Indeed, they cannot since they are 18/8 stainless steel through and through. And they can be fitted with TRU-LOC end attachments—the fitting that develops 100 per cent efficiency.

● American Cable engineers pioneered and developed preformed rope. This development put a stop to dangerous, insecure splicing. It made the cable last longer—made it resist bending fatigue so successfully that smaller diameter and lighter sheaves could be adopted. It made possible the 100 per cent efficient TRU-LOC fittings.

● Available in galvanized, tinned or "KORōDLESS" (stainless steel) American Cable Aircraft Controls have done much to advance the safety of flying. They meet every Army or Navy specification. Use American Cable controls and fittings in your craft. Made by the manufacturers who are *"In Business for Your Safety."*

AMERICAN CABLE DIVISION
AMERICAN CHAIN & CABLE COMPANY, Inc.
WILKES-BARRE, PENNSYLVANIA

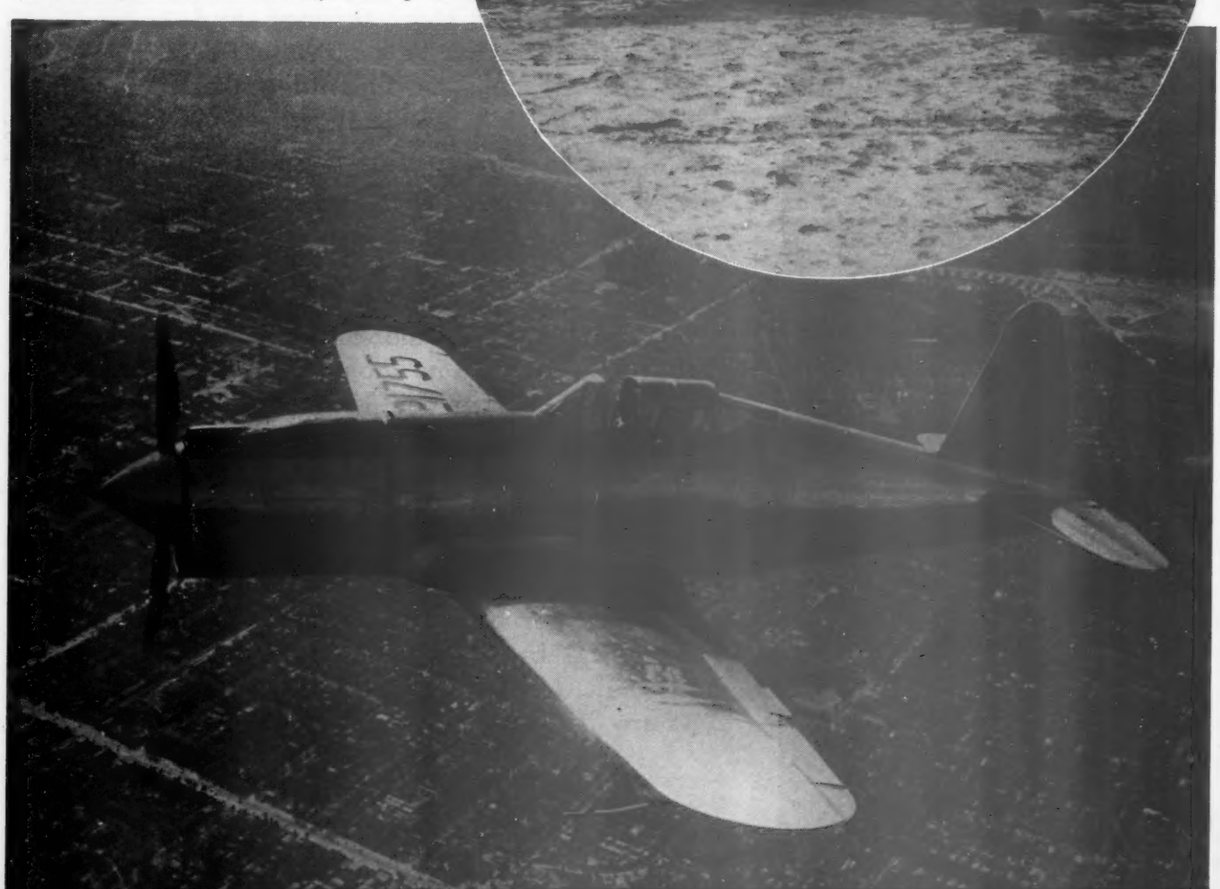
Aircraft Department—230 Park Avenue—New York City

AMERICAN CABLE *"Korodless"* AIRCRAFT CONTROLS

KOLLSMAN PRECISION INSTRUMENTS have been selected as standard equipment on the REPUBLIC EP-1 and the VULTEE "VANGUARD" airplanes now being manufactured in this country for the Royal Air Force of Sweden—a choice for which there is the best of reasons... previous long and satisfactory experience with Kollsman Instruments on the airplanes of the Swedish Air Force.

Republic EP-1

The Vultee "Vanguard" shown below is powered with an experimental engine; the Vultees built for the Swedish Air Force are powered with Pratt-Whitney Radial Engines.



KOLLSMAN INSTRUMENT DIVISION OF THE SQUARE D COMPANY
8008 FORTY-FIFTH AVENUE, ELMHURST, NEW YORK
WESTERN BRANCH: GRAND CENTRAL AIR TERMINAL, GLENDALE, CALIFORNIA

(*Continued from page 112*)

make an air Blitzkrieg successful but not when ratios are much less than that amount, as it must be remembered that there is an inherent advantage for defense, particularly in the air. At the present time, this relationship favors Germany by about 1.3 to 1, with the gap rapidly closing.

This analysis is based on the present line-up of the nations at war. No mention has been made of the possibilities of the scales being weighted one way or the other by the entry of Russia or Italy into the major conflict. It seems to me doubtful, although admittedly unpredictable, whether these countries will engage actively and, in the case of Italy, there is further substantial doubt as to the side with which she will cast her lot. Then there are balancing possibilities which cannot now be appraised with certainty, such as Scandinavia, the Low Countries, the Balkans, and Turkey.

Certain it is, however, that Air Power has acquired determining importance in warfare because of its dual role: it is the eyes of the army and navy; and it possesses tremendous striking power of its own. It seems likely therefore, that the eventual outcome of the war will be largely affected by the relative strength in the air that each side can muster. I feel that Germany's past supremacy and present small superiority in the air will be overcome by the Allies. The curves shown should approximate the situation. Assuming substantially equal land forces and land defenses; and continuing Allied supremacy on the sea; and economic superiority for the Allies in access to world markets and in financial means of exchange; then, once air equality is attained, the outcome will not remain long in doubt. This time should arrive late in 1941 or early in 1942, and with it, Allied victory.

The world has had to relearn this lesson the hard way: policy must always be backed by strength. This holds whether international affairs fall into the scheme of power politics or collective security. Collective security, in the form of the League of Nations, was tried after the last war. It proved insecure and failed since collective strength was not behind it. Realizing the determining importance of Air Power, Germany secretly started her air rearming. She built up an efficient industry and then openly extended her air force and by threat of its use, acquired much of what she wanted. If the world has learned the lesson sufficiently well, then after this war we may possibly hope to look forward to a more effective collective security. When backed by overwhelming air power, some future federation, or union, or league will possess a means of keeping the peace far superior to any yet devised. Then the airplane will assume a new dual role in civilization: the most rapid means of transportation, for bringing people closer together, and the guardian of peace for enforcing and insuring success of the next form of collective security.

TOTAL AIR POWER

First Line	**30%**
Reserve	**20%**
Cooperation	**20%**
Training	**30%**
	100%

Above proportions are approximate, varying for different countries and at different times.

Quantity Production

(*Continued from page 49*)

valve tappet support ledge and intake pipe flange ledge, which are located on the same face.

Another simultaneous milling operation on a Milwaukee horizontal mill is made possible through designing the location of the cylinder base, intake manifold hold and valve tappet follower hole so that a triple boring head can drive all three tools at one operation. In this case the boring operation performs a rough and finish cut in continuous sequence, as the case design permits the rough tool to continue on down through the hole until the finish cutter comes in contact with the work.

Careful design of the rear crankcase cover has simplified machine work and also made the accessory case more accessible for servicing. The two magneto drive gears are mounted to the rear case and remove with it, thus exposing the accessory drive gear train, which includes five individual cam gears, one for each cylinder. The rear cover accessory mounting faces for the oil pump, tachometer drive, starter adapter and relief valve on the oil pump assembly, are all faced in one cut through use of a large diameter cutter.

The master connecting rod and link rods are all of "H" design, rather than "I" section, although the latter is supposed to be slightly lighter in weight. Use of the "H" section permits simple slot milling of the rod forgings and eliminates the expensive job of end milling necessary with "I" section rods. Machining of these rods is further speeded up through use of twin fixtures in a Cincinnati horizontal mill, permitting milling of two rods at a time.

Simplified production design extends to many of the small parts used throughout the engine, serving to produce precision work with maximum economy. For example, the cylinder head bolts to the cylinder barrel instead of being screwed on. Extensive research developed a type of special ground seat, which, in connection with a soft copper gasket, serves to seal the flange perfectly between head and barrel. Also, the valve rocker arm assembly was materially simplified through development of a special roller bearing and rocker arm axle, with locating washers. This unit is purchased to our specifications from a bearing manufacturer and materially simplifies machining of the cylinder head rocker box.

We have economized in another way through sub-dividing the engine into the maximum number of sub-assemblies, which greatly simplifies and speeds final assembly work. Thus the final assembly is broken down into: crankcase assembly, crankshaft and master rod assembly, cylinder and head assembly, and miscellaneous small assemblies and optional equipment. Various further subdivisions are made under each of the assemblies named, so that each man can work without interference, and parts and assemblies all flow smoothly to the final assembly line with all preliminary fitting and inspections already performed so that the final operation of bringing sub-assemblies together is performed without a hitch.

The above examples will illustrate our effort to speed production through forethought in the engineering department, rather than through pressure on the machine shop. We are continuing this practice, in close cooperation with the production department and constantly find new ways in which engineering changes, sometimes slight in themselves, permit material economies or improvements in machine practise. all of which contribute their part to quantity production of engines.

Amber Lights for Runways

(*Continued from page 54*)

losses in particles of fog, which act as prisms when rays of light strike them. The explanation for this is coincident with the reason for colored sunsets. An observer looking toward the setting sun receives a predominance of red and yellow light since the longer wave lengths of these colors are bent less when they strike the earth's atmosphere than are the blues and greens. Consequently, they travel in a shorter line through the atmosphere than the other colors and are subject to less atmospheric absorption. This does not mean that red and yellow actually penetrate any better than equal intensities of blue and green which have shorter wave lengths, but the reds and yellows are not equally subject to the halo effects common in fogs in which the excess scattering of the shorter wave lengths builds up a glare around the source. An observer would see the sodium light source itself and not a general blur or halo in the direction of the contact light. A common application of "fog lights" is found mounted on the front bumper of many automobiles. In this case, the theory of minimum refraction has been applied. However, filtering is not necessary with sodium vapor since the lamp delivers all its light in this single yellow band.

Several years ago a sample installation was tested at the Akron airport, and results proved the correctness of the original ideas. Table I shows the findings on the comparative visibilities of sodium and incandescent lamps under various atmospheric conditions. These results are based on equal intensities at the two light sources.

To apply completely this principle of minimum refraction, neon would have been the ideal gas to use. The emission from this gas has the longest wave length in the visible spectrum and is familiar to everyone through its use in outdoor advertising. The fact that red lights are interpreted the world over as danger signals prohibited its use at airports. The original sodium lamps used in contact lights employed a small amount of neon gas which served to conduct the primary flashover in the lamp. This resulted in a reddish hue until the sodium had vaporized and began to emit its characteristic yellow light. The red light was confusing to pilots, and it was necessary to replace the neon with other rare gases that would not impart any reddish hue.

Restrictions imposed by the Civil Aeronautics Authority required that the lamp come to 50 per cent of full brilliance within 15 minutes at temperatures above 40 degrees Fahrenheit. The limitation holding the maximum height above ground level to less than two inches prohibited the conventional double-wall glass flash which is evacuated to prevent the leakage of heat from the lamp. It was necessary to design a single-wall glass flash and heat reflector which fitted between the lamp and the flask to perform this function. The heat reflector was provided with windows to allow free emission. Consequently, it was found that such a lamp reached an intensity of 100 (about 40 per cent of full brilliance) candlepower in eleven minutes at normal room temperatures.

The case distributes the light asymmetrically through an angle from one to ten degrees above the horizontal. This angle coincides with the angle of the plane's approach and provides as much light as possible for the incoming pilot. The use of concentrated beams was avoided since the pilot could see them only if he were directly in the path of these beams. If he were slightly off the center line of the runway, only a few isolated units would be visible, instead of a row on each side as was desirable. Furthermore, it was necessary to design the units to withstand the weight of the heaviest planes in operation since the units were to be set just off the edge of the runway.

The sodium lamp finally developed for airport use consists of a glass bulb 8½ inches long, housing the cathodes, and a four-prong base of molded material. The bulb contains sodium in solid state when unlighted and a small amount of rare gases at a pressure of three millimeters of mercury. When the lamp is started, these gases supply ions for the conduction of the arc stream. As the discharge continues, the energy consumed in the tube increases the temperature and serves to vaporize the sodium which in turn increases the pressure still further. A thermal switch is shunted across the lamp terminals to allow the cathodes to warm before "striking." If the full pressure of the circuit were applied across the cold cathodes, the initial flashover in the lamp would remove an excess amount of activated plating from these cathodes. The lamp is designed to operated on a 6.6-ampere straight series circuit and has an average life rating of 2,000 hours.

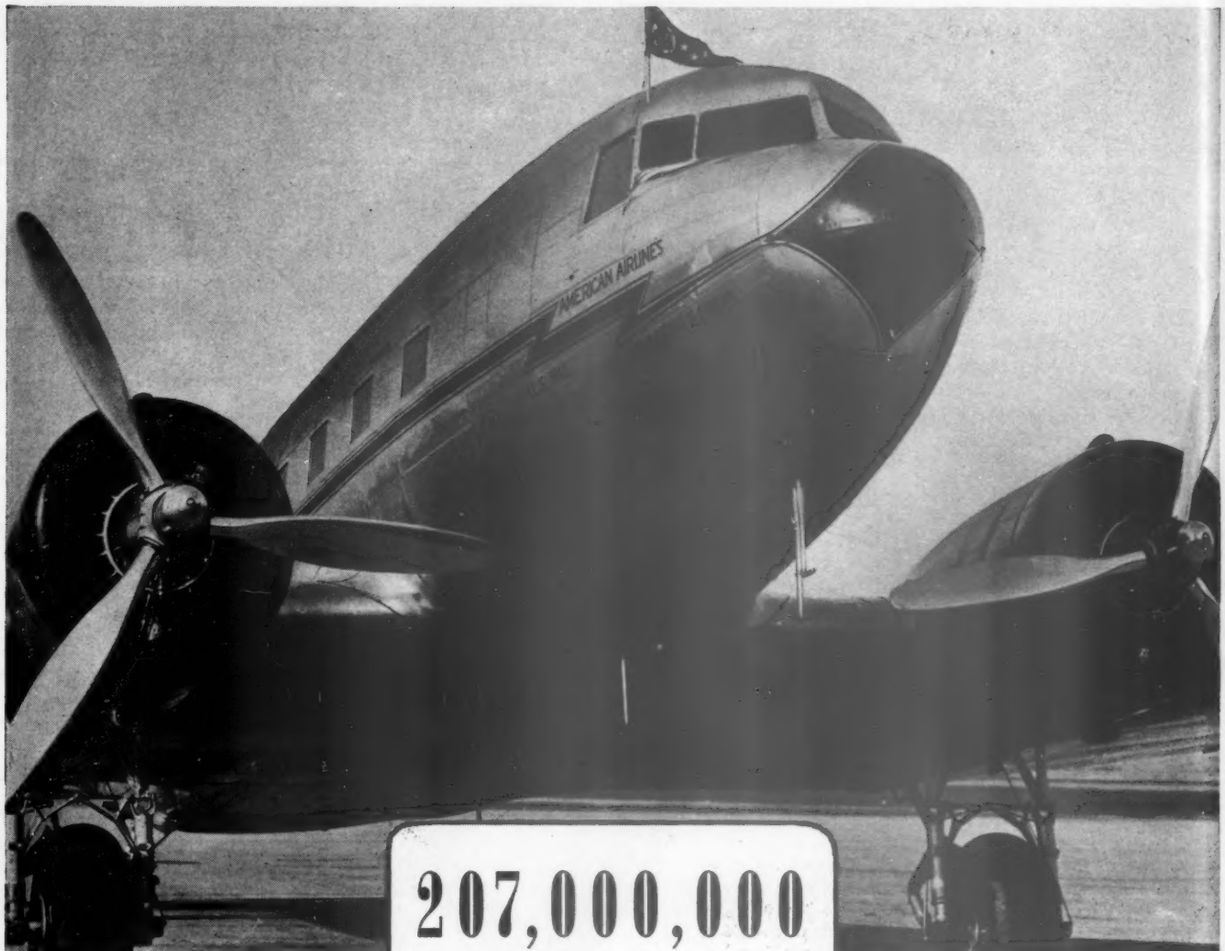
With this plan of correlating instrument and contact landings, the following procedure should be followed. Rows of lights should be placed on either side of the runway with 200 feet between the rows and 200-foot spacing between the units. Cable loops should be left halfway between each contact light so that the spacing may be decreased to 100-foot spacing with no difficulty. It is understood that 100-foot spacing may become standard practice in the future. The first 1,000 (or more) feet of a runway equipped with radio beams for instrument landings should be yellow and the remaining 3,000 feet should be white incandescent. Thus, the pilot receives indication from the change in color when he has 3,000 feet of runway remaining. At that point he can determine whether to complete the landing or to stay up, circle and try again.

TABLE I

A Comparison of the Penetrating Qualities of Sodium Vapor and Incandescent Contact Lights Under Varying Conditions of Visibility

	Incandescent	*Sodium*
Weather Clear	2 miles	2 miles
Slight Haze	4,500 feet	2 miles
Ground Haze	2,250 feet	2 miles
Haze and Smoke	410 feet	1½ miles
Medium Haze	270 feet	6,200 feet
Light Fog	155 feet	4,110 feet
Medium Fog	76 feet	1,040 feet
Medium Fog and Smoke	33 feet	420 feet

F4F-3
The U.S. Navy's
latest Fighter
HEASLIP
GRUMMAN AIRCRAFT ENGINEERING CORPORATION • BETHPAGE • LONG ISLAND • N. Y.



207,000,000 MILES

DURING 1939, American Airlines Flagships flew a total of 207,360,-215 revenue passenger miles, a 48% increase over 1938.

Pictured above is one of fifteen Douglas DC-3 Flagships, recently added to American Airlines Service.

All American Airlines Flagships are equipped with Holley Non-Icing Aircraft Carburetors.

HOLLEY CARBURETOR COMPANY • AIRCRAFT DIVISION • DETROIT, MICHIGAN

★ HOLLEY ★

AIRCRAFT CARBURETORS

Airline Safety Through Teamwork

(*Continued from page 41*)

The story of the vital part played in airline safety by the maintenance departments of the lines is too long a tale to be gone into here. It is not new to readers of this magazine, as AVIATION has devoted many pages to the steady advance of methods and procedures. Our special maintenance issues have been a pictorial history of the careful work that is being done on U. S. airlines.

In the airlines, preventive maintenance is carried to a point that may seem fantastic to anyone who has never visited an airline overhaul base. None of the thousands of mechanical parts of an air transport wears out. They are replaced long before vibration or stress may weaken them to a critical point. A huge air transport gets more attention and is looked after more carefully than any million dollar baby, surrounded by physicians, nurses, governesses and dieticians.

Literally hundreds of items on the airplane are checked regularly. A step-by-step routine is followed. Nothing is missed. One airline has its maintenance routine worked out so carefully that its procedure manuals occupy three volumes, each the thickness of a New York telephone book.

Through the maintenance department, as well as in the operations divisions, training goes on night and day. Prospective mechanics are scrutinized carefully, and only the best candidates are accepted. Then they are put to school, either in formal classes or under the training of an old-timer. Training is practical, thorough, and continuous. As a class of mechanical workers, there is probably no more dependable group of men in the world than the airline mechanics. Integrity is their middle name. They deserve much of the credit for the airline safety record that has been established.

Air Transport Association

One airline by itself cannot possibly solve all its problems. In 1936 the lines realized that while competition was all right for the sales and advertising departments, only a combined attack on operations and maintenance problems would get them anywhere. So they joined together and formed the Air Transport Association of America and hired two experienced and forceful men to run it for them, Col. Edgar Gorrell and Fowler Barker.

The contribution of ATA to airline safety cannot be overestimated. Under its leadership maintenance men, for example, get together several times a year. Their problems are the same. They talk over anything from hiring and training mechanics to new ways of solving fuel problems. Into the common pool of information go all their best ideas. No secrets are withheld. Maintenance men are keenly aware that it is a case of, "United we stand, divided we fall," and the union today is strong.

One line invents a device that overcomes static in ships' radios, another learns that a change in inner cowling design will serve as a fire prevention device, another is able to lessen vibration in fuel lines, another invents a fool-proof work stand, or a new way to move engines about the hangar, or repair a complicated instrument—all are turned in for the other fellow's benefit. Large lines with money to spend for research kick in their discoveries to the small line that has only half-a-dozen airplanes. In the process, safety marches on.

In other airline departments as well as in maintenance, the Air Transport Association has brought the lines together. All phases of operations are coordinated. ATA holds meetings in which manufacturers, government officials and other groups concerned with airline problems, get together and thrash things out until conclusions are reached which bring progress to air transportation.

Civil Aeronautics Authority

In the year and a half of its existance, CAA has done much for airline safety. It has greatly improved the physical equipment that aids air navigation, both in and out of the airplane. Airports are better, (thanks also to the much criticized WPA), radio ranges and beacons are more efficient, air traffic control at busy airports is handled more easily with less confusion and regulations pertaining to air navigation are better.

Many standards that have been set for airline performance have contributed to the safety record. CAA has studied the best practices in air transportation, in both operations and maintenance, and said, "This will make airline flying safer. All lines must follow this practice." The use of full-feathering propellers is one of many such regulations. Licensing of dispatchers has improved their standards.

CAA was largely instrumental for getting the lines to agree on stopping "racing" between competitive points, such as the New York-Chicago run. Now when weather is doubtful, the lines are much quicker to cancel flights. Engines are operated at a lower percentage of their maximum output, which is beneficial. Up and down the airlines CAA men are working with all operations and maintenance departments, striving always to improve efficiency and safety.

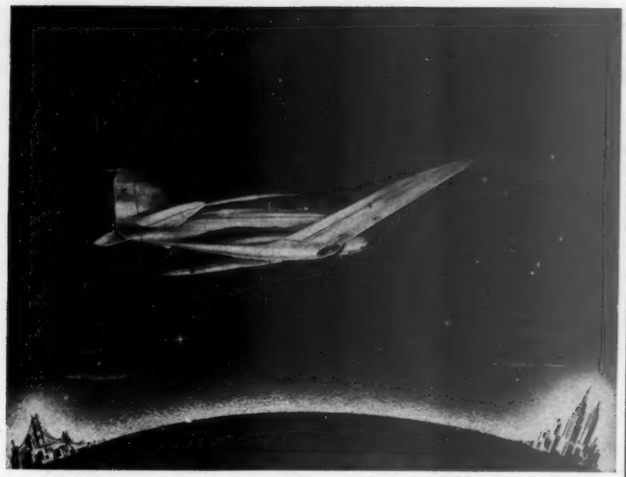
When the Civil Aeronautics Authority superseded the Bureau of Air Commerce in August, 1938, another new organization came into being—the Air Safety Board. Although it works closely and harmoniously with CAA, it is an independent board, controlling its own finances, and not responsible to CAA. Its sole purpose is to improve safety in scheduled and non-scheduled flying. It does this by a three-fold program: investigation, recommendation, and publication. It has no power of law enforcement, and the CAA may accept its recommendations or not. However, its work to date has been so well done that it has earned the respect of the entire industry.

Following an accident involving any certified aircraft, the Safety Board goes into action. It makes a painstaking investigation, during which it uses its own trained engineers as well as outside experts, makes a recommendation so that similar accidents may not happen again, and publishes its findings. Nothing is overlooked, nothing is hushed up. Its accident analyses are undoubtedly the most thorough in the world. The Board is playing an important role in airline safety.

Air Line Pilots Association

In the final analysis, it is the pilot who knows more than anyone else about the operation of his airplane. He and his co-pilot are aloft hour after hour, month after month, and year after year. These are the men who fly the lines, day and night, in all sorts of weather and over all the routes. It is they who give the real test to new propellers, radios, carburetors, engines and airplanes. If the airlines of America have estab-

(*Turn to page 122*)



. . . for men who treasure TIME . . .

THERE is about successful men this common characteristic: while rich in achievement, they feel a constant poverty of *time*...The week has too few days, the day too few hours to satisfy their urge for action.

It is natural that such men should fly, because flying multiplies productive hours; and logical that they should choose the *SPARTAN* because they recognize, in this smart sleek aristocrat, the embodiment of all the features they seek in a private plane—a masterpiece of specialized engineering, fashioned by men who for 13 years have devoted all their skill and energies to the development and production of *private* planes.

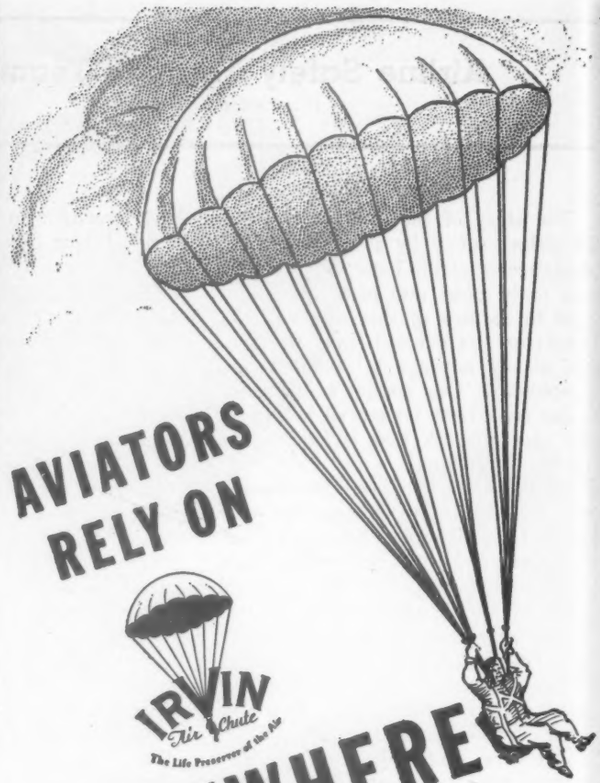
You see the evidence of specialization in every detail of the *SPARTAN*—in its speed and safety; in the trim grace of its lines and the luxury of its appointments; and most important, in its amazing maneuverability — eager response without tricky handling or treacherous controls. It's hard to realize that such an aristocrat is actually the lowest-priced all metal plane in its class!

Successful men, sportsmen and executives, will be interested in details of the *SPARTAN*. We shall be happy to forward them on request . . . *SPARTAN* AIRCRAFT COMPANY, TULSA, OKLAHOMA, U. S. A.

★ *Some territories still available. Inquiries invited from responsible distributors.*

★ SPARTAN ★
Executive

Aristocrat of the Airlanes



AVIATORS RELY ON IRVIN Fire Chute The Life Preserver of the Air EVERYWHERE

Around the world—in private, commercial and government aviation —the name "Irvin" symbolizes SAFETY. The air forces of forty-five nations, including the United States and Great Britain, use IRVIN parachutes as standard equipment. Test pilots depend upon them. The world famous Caterpillar Club has 3,000 members—all of whose lives have been saved with IRVIN parachutes.

IRVIN AIR CHUTES ARE DOMINANT

in the leading aeronautical schools of America and are preferred for use in the Civil Aeronautics Training Program. Descriptive literature and fundamental facts sent to school executives on request.

Our Engineers are at your service.

IRVING AIR CHUTE CO., Inc.

1670 JEFFERSON AVE., BUFFALO, N. Y.

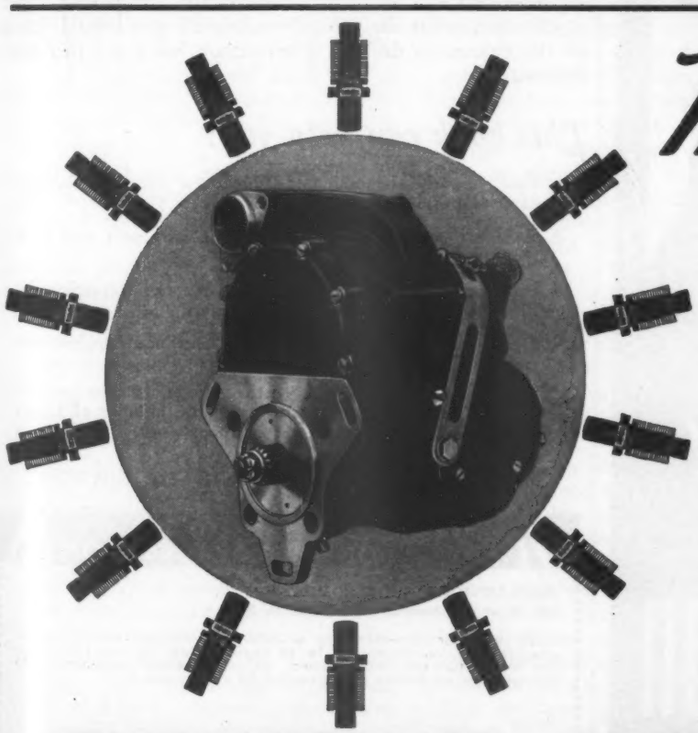
Factories at: Buffalo, N. Y.; Glendale, Calif.; Fort Erie, Canada; Letchworth, England; Bucharest, Rumania; Stockholm, Sweden and other countries.

She's as Smooth as Silk, Too!

THE NEW CULVER'S GOT EVERYTHING

That's what those "in the know" say who have watched her tests and "patted" her smooth-as-glass, ultra-streamlined "form".

Accessibility, maneuverability, speed, power, safety—more than you have a right to expect in a much higher priced ship—yet she's priced in the $2000 range . . . and ready soon for those who want something startlingly better in the deluxe lighter plane class.



Matched!

to each other and to Aviation's matchless engines!

The engineering excellence, the production precision, that go into the modern aircraft engine, deserve ignition of comparable caliber. Scintilla Aircraft Magnetos, Spark Plugs, Radio Shielding and Ignition Switches, virtually hand-built to standards of quality as high as the most modern methods can lift them, admirably match the great engines in which they serve. Ignition by Scintilla has become a reliable identifying mark of the finest aircraft engines, whether they be 40 horsepower or two thousand.

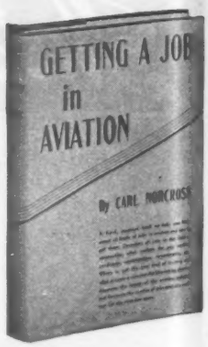
SCINTILLA MAGNETO DIVISION
BENDIX AVIATION CORPORATION
SIDNEY, NEW YORK

BENDIX-SCINTILLA

Aircraft Magnetos and Spark Plugs

Jobs!
Jobs!
Jobs!

Here is a book to bring you nearer to the job in aviation *you want.* Get the facts you need from men who know — clear up your questions as to work, training, requirements, etc., etc.



GETTING A JOB IN AVIATION

By Carl Norcross

New York State Education Department

374 pages, illustrated, $2.50

DR. NORCROSS has written a valuable book for all young men interested in aviation careers. He has traveled to all parts of the country, to all branches of the industry where he has asked a great many questions about jobs. The result is a frank and practical guide to employment possibilities in aviation.

If you could get in to see and talk with famous aeronautical engineers, or pilots, or employment managers of air lines and had an opportunity to ask, "How can I get a job—and what do you recommend?" you would jump at the chance to do so. The author has done just that for you.

This book can help you:

1. **Find out the beginning qualifications for jobs in the particular field of work which interests you.**
2. **Tell how much money the training will cost and how long it will take.**
3. **Find out the work being done by persons following the branch of aviation you hope to enter.**
4. **Decide whether you can meet the entrance requirements for the job you have in mind.**
5. **Gain exact information as to the number of jobs in aviation now open and a *forecast* as to the number of future jobs in different lines of aeronautical work.**

EXAMINE IT 10 DAYS—SEND THE COUPON

McGRAW-HILL ON-APPROVAL COUPON

McGRAW-HILL BOOK COMPANY, INC.
330 West 42d Street, New York, N. Y.

Send me Norcross—Getting a Job in Aviation, for 10 days' examination, on approval. In 10 days I agree to pay $2.50 plus few cents postage and delivery, or return book postpaid. (We pay postage on orders accompanied by remittance.)

Name .....

Address .....

City and State .....

Position .....

Company ..... Av. 4-40

(Books sent on approval in U. S. and Canada only.)

Ultra High Frequency

(*Continued from page 45*)

approximately 600 feet and over the inner marker at approximately 60 feet.

In conjunction with the instrument landing equipment, a monitor and control system is installed in the airport control tower for use in remotely operating the facilities on the runway appropriate to the wind direction at the time and to provide continuous indication that the equipment is operating satisfactorily. The monitor equipment provides both a visual and aural indication of the signals radiated from the localizer, glide path, inner marker and outer marker equipments and in addition indicates which one of the four runways is in use for instrument landing.

Airport Traffic Control

With the establishment of airport traffic control by radio at the major airports throughout the country, a transmitting frequency of 278 kilocycles was selected for communication purposes from all airport traffic control stations to aircraft. Communication from aircraft to ground is carried on at frequencies in the band 3000 to 6000 kilocycles. The use of 278 kilocycles for this service has proved to be unsatisfactory, mainly because of increased traffic, atmospheric disturbances, and interference from traffic control transmitters located at other airports. In searching for a solution to this problem, the use of ultra-high frequencies was investigated.

In the early part of 1937 an experimental ultra-high-frequency crystal-controlled telephone transmitter operating on a frequency of 125 megacycles and having an output of 100 watts was installed at the Indianapolis airport. An antenna system located approximately 50 feet above the ground level and consisting of a vertical half-wave copper tube and "J" type matching section was installed on the control tower. A series of comparative tests were conducted using the regular 278-kilocycle frequency and the ultra-high frequency of 125 megacycles. The results obtained in these tests indicated a marked improvement in service on the ultra-high-frequency transmission with nearly complete freedom from atmospheric disturbances. In addition, desirable propagation characteristics were obtained which would tend to minimize the interference between airports. Work has begun on a program looking to the ultimate replacement of the present low-frequency traffic control stations now in use at all main airports with a system using frequencies in the band 129-132 megacycles.

Aircraft-to-Ground

In the United States at the present time nearly all communications from domestic aircraft to Government ground stations are made on the frequency of 3105 kilocycles or the auxiliary frequencies of 3120 and 6210 kilocycles. Transmissions on these frequencies are subject to sporadic fading, skip effects, atmospheric interference, and radio interference. In addition, a transmitting antenna appropriate to such frequencies adds a high aerodynamic drag to the aircraft. In order to improve communications and avoid some of these difficulties, an investigation was conducted in the use of ultra-high frequencies for this service.

In the early part of 1939, an ultra-high-frequency telephone transmitter operating on a crystal-controlled frequency of 141.78 megacycles with an antenna output of 5 watts and capable of 100 per cent voice modulation was installed in an airplane. The transmitter was designed for aircraft use and weighed 21 pounds. A vertical one-half wave "whip" type antenna similar to the type used in automobile service was mounted on top of the fuselage and was connected to the transmitter by means of an asymmetrical pi-type matching section and a 70-ohm coaxial transmission line. A crystal-controlled superheterodyne receiver was used to receive the transmissions at the ground station and was connected by means of a coaxial transmission line to a one-half wavelength vertical antenna mounted on a 60-foot wooden pole.

Flight tests were conducted and it was determined that with the aircraft flying not less than 1000 feet above the ground level, the transmission performance for a radius of 50 miles was greatly improved when compared with present frequencies and equipment. At an altitude of 4000 feet above the ground level, the radius was found to be approximately 90 miles. The outstanding improvements observed in these tests of ultra-high-frequency transmission was the freedom from fading and background noise and a reduction of the antenna drag to less than one quarter of that of the low-frequency type. Pronounced improvement in the radio interference problem is anticipated due to the propagation characteristics at this ultra-high frequency.

As a result of these tests, a frequency of 140.1 megacycles was proposed to replace the frequency 3105 kilocycles now used by aircraft to contact Government and airport traffic control stations.

Synthetic Rubber

(*Continued from page 62*)

resistance to swelling by anti-freeze compounds and has good mechanical properties. Under loading it exhibits very little tendency to cold flow and has good resistance to high temperatures, tending to slow hardening only above 200 deg. F. This material is supposed to be as abrasive resistant as rubber. In automotive shock absorbers it has withstood many cycles of operation without abrasion while its ability to resist distortion due to cold flow and a minimum amount of swelling in the presence of the fluid made it a successful application.

PVA is a recently developed synthetic which possesses the most toughness of any of the materials discussed. It is the most resistant of all to ordinary oils and solvents; is highly resistant to failure by flexing or twisting; has high tensile strength; and has about one-twentieth the permeability of rubber. It swells very little in oil and for that reason has been used for valve seats in an application where no water was present. Because of its basic chemistry, this material will break down completely when immersed in water, alcohol or glycerine. Because of its strength it can be used in pressure or vacuum systems and because of its resistance to solvents it has been used to handle refrigerants.

Each of these types of synthetic rubber-like materials can be made to possess varying degrees of resilience, elasticity, abrasion resistance and hardness. These qualities depend entirely on the composition of the mix. For example, carbon black can be added to improve abrasion resistance.

Synthetic rubbers can be compounded with natural or reclaimed rubber but the oil resistance and certain other qualities of the true synthetic rubber decrease in direct proportion to the percentage addition of rubber. This may or may not be a detriment depending on the final design results desired.

Cabin Superchargers

(*Continued from page 47*)

tween cruising and take-off conditions. The widest range of speed at the present time seems to be 1,600 r.p.m. for cruising and 2,600 r.p.m. for takeoff, with other designs having the same take-off speeds and cruising speeds ranging up to 2,000 r.p.m. This places the centrifugal supercharger at some disadvantage, as the pressure ratio necessary to maintain the desired altitude in the cabin depends upon the square of the impeller tip speed, and this speed must be maintained at cruising r.p.m. Under take-off conditions and single-engine operation, the pressure is very much higher than necessary, due to the increase in r.p.m. and, in spite of throttling the inlet to maintain the desired cabin pressure, may involve large power losses and high temperatures. To a certain extent this objection can be overcome by the use of a clutch, as the cabin supercharger does not need to be operated at sea level or at altitudes where take-off occurs. The centrifugal supercharger can be completely disengaged from the main engine until an altitude is reached where pressure is required. At this point the design of the supercharger will again be based on operating requirements. If it is permissible for the pilot to throttle his main engine to the lowest possible speed before engaging the supercharger, a simple type of automotive clutch can be provided. However, if it is necessary to engage the supercharger without disturbing engine operation and at the ordinary cruising speed of the engine, it will undoubtedly be necessary to provide centrifugal clutches, which require from one to three seconds to bring the drive shaft up to the normal operating speed. Such clutches have already been developed and tested in experimental two-speed and two-stage superchargers and operate extremely well. They are more complicated and expensive than the ordinary automotive type of clutch, and will increase both the weight, bulk and cost of a cabin supercharger requiring their use. A Roots blower practically eliminates the necessity for a clutch, for if the total volume of air is by-passed, the load on the supercharger is only a small portion of the total load and represents friction plus the power necessary to move the displaced volume of air from one side of the blower to the other. This characteristic may become quite important for certain types of operation.

The weight of a cabin supercharger depends upon the type, pressure head, capacity, whether or not clutches are used, and what accessories and drive, if any, are used in connection with the supercharger. A simple single-stage centrifugal supercharger having a compression ratio of 1.4: 1 and delivering 200 to 300 cu.ft. per min. of free air weighs about 35 lbs. without drive shaft or coupling. From this value, weights will range up to about 85 lbs. for a 2 stage centrifugal supercharger with an overall compression ratio of 2: 1 and a capacity of from 200 to 300 cu.ft. per min. complete with drive shaft and universal joints, clutch, torsional vibration dampener, self contained oil system, and integral automatic regulator. A simple Roots blower having an air capacity of 50 cu.ft. per min. weighs about 12 lbs.; sizes capable of delivering 200 to 300 cu.ft. per min. at ordinary cabin pressures will weigh from 50 to 70 lb. without drive shafts or couplings. These weights are all based on the use of heat-treated aluminum alloy castings, which have proved more practical for this purpose than any of the magnesium alloys.

Lubrication is an important problem, particularly on centrifugal superchargers, where oil vapor must be kept from mixing with the air delivered to the cabin.

A large percentage of the engine manufacturers prohibit the return of oil from an accessory to the engine tank or crankcase, making it practically mandatory for cabin superchargers to have their own oil supply and pump. In a centrifugal supercharger a self contained oil tank holding about 1 gal. of oil may be used, with an oil pump for supplying the necessary pressure. All lines can be drilled or cored in the castings, and the pressure oil can also operate an integral supercharger regulator so that no external oil lines or fittings are required. The gears and bearings of a Roots blower are ordinarily lubricated with a heavy oil such as 600 W, which will last from 50 to 100 hours of operation without inspection or changing.

Basic air controls for the cabin are essentially a means for maintaining the desired pressure, means for controlling the mass flow of air to the cabin, a differential pressure valve opening to the outside atmosphere, which will limit the differential pressure between the inside of the cabin and the outside air, and an inwardly opening valve which will prevent higher pressure outside the cabin than inside.

Various systems have been proposed for the control of the supercharged cabin. The simplest of all is an opening in the cabin wall capable of passing a certain number of cubic feet of air per minute at a definite pressure difference, and a control on the cabin supercharger which by throttling or by-passing the air maintains a constant cabin pressure. Many comments have been made regarding the desirability of a uniform air flow to the cabin. The writer believes that cabin controls will be largely simplified if the minimum flow is specified and a reasonably large amount of excess air flow permitted. This will not involve a question of additional heat as the compressed air is ordinarily above the temperature of the air in the cabin. By throttling the inlet of a centrifugal supercharger to maintain cabin pressure, and providing a discharge valve from the cabin, with an opening which varies with outside barometric pressure, practically a constant air flow can be maintained. It is also practical to place a venturi in the air line between the supercharger and the cabin and use the pressure differential across the venturi as a means for measuring and automatically controlling (by means of a supercharger regulator) the air flow into the cabin. By making slight modifications to a standard supercharger regulator (such as are used by the Army to control the output of turbo superchargers, or on the power control of P & W engines) a completely automatic control is possible, both for cabin pressure and for mass flow to the cabin. The other valves are inherently automatic and require no manual attention. In a positive displacement pump such as a Roots blower, running at a constant speed for any given set of conditions, the pressure may be maintained by by-passing excess air from the blower. The blower capacity is such that at rated altitude it gives both the desired cabin pressure and the desired air flow. At lower altitudes, as the inlet air density increases, the amount of air by-passed also increases, so that a substantially constant mass flow can be maintained by a single regulating valve. In addition, the discharge from the by-pass can be carried to the cabin for ventilation at low altitudes and a single supercharger regulator can be used to control both ventilation to the cabin and cabin pressure at all operating altitudes. If wider changes in air flow may be permitted, the entire output of a Roots blower may be piped directly into the cabin.